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RELATIONSHIP OF MAXILLARY AND MANDIBULAR GUM PADS IN THE NEWBORN INFANT*

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IT IS an acknowledged fact that there is still need for further research in the etiology of malocclusion. In many instances it would be better to start anew than to continue on some speculative tangent with nothing more than a notion to substantiate it. Because of the complexity of the problem, it would simplify matters a great deal to determine its limits.

Brash asked, "How early may irregularity and malocclusion as such be recognized?" In order to find the answer to this fundamental question an investigation was started which began at birth and is to be continued through the stages of growth and development. This paper which comprises the first part of this investigation is confined to the newborn infant. Future findings will necessarily have to be reported at a later time.

Observations have been made of 709 infants from 1 to 11 days of age and 134 sets of maxillary and mandibular impressions were taken on 113 of these babies, articulating the stone casts by means of an individual bite. This study will present evidence bearing on such questions as: What is the relationship of the maxillary and mandibular gum pads in the newborn infant? Does the varied relationship of the gum pads have any effect on their dimensions? Are these dimensions affected by the type of delivery?

There is little information on this subject. Hellman in 1914 observed two newborn infants and one two weeks old; he found that "the upper alveolar process was in advance of the lower and the expression about the mouth resembled very much that which was so closely related to a case belonging to

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Class II, Division 1 in the adult." Weinberger in 1916 showed a series of skulls with the mandible in normal, distal and mesial relationship. He concluded "That whatever the early embryonic or foetal malformations might be, they are generally retained in a marked degree in adult life."

Friel in 1926 stated, "At birth these pads do not meet in the anterior region. as the tip of the tongue lies between the two pads. There is not much variation in the anteroposterior relationship of these pads, the lower pad seems to be as far forward as the upper pad, though in one case examined the lower pad was in postnormal relationship. There seems to be no definite occlusion of the segmented gum pads, which have been so graphically described by West. The thickness of the upper lip anteroposteriorly gives the appearance of a postnormal relationship of the mandibular alveolar arch."

In discussing Friel's paper, Wilkerson stated that his observation led him to believe that at birth the gum pad of the mandible is posterior to that of the maxilla. Friel, in answering Wilkerson, commented, "fifteen cases were examined and out of these, twelve showed the alveolar pads at the same plane anteroposteriorly. One was undoubtedly postnormal; the mandible was distal to the maxilla, and in the other two cases it was very doubtful as there was great difficulty in examining the child."

Brash in 1929 wrote as follows, "In a private communication, he (Dr. Friel) tells me that he has again visited the Rotunda Hospital and had examined, with Dr. Solomons, some dozen infants a few days old, among which he incidentally found one infant two days old with two central incisors erupted. But, with the exception of two infants whose mandibles were definitely 'postnormal,' Dr. Solomons could make the gum pads meet in front in every case. But he had to use what Dr. Friel calls 'a certain amount of force,' and it seems to be probable that what really happened was that the mandibles revolved round the higher portions of the gum pads in the molar region; and there we shall have to leave in the meantime this interesting and obviously simple anatomical point upon which further evidence should be readily forthcoming. The whole subject of foetal variations in the jaws is a fascinating and attractive field and one that should not be very difficult to cultivate; but, in the absence of anything more than a few preliminary excursions into it, we must content ourselves with observing that there is a strong probability of a considerable range of variation in the position of the tooth-sacs, certainly in the form of the jaws and in their relation to each other, and that there is at least some evidence that variations similar to those found in subsequent recognized malocclusions may be already present at or before birth."

Clinch in 1932 made a unique and interesting investigation. Observing the relationship of the gum pads in 400 infants, she classified them into three types. Her Type 1, in which the anterior margin of the mandibular first molar segment lies slightly anterior to the anterior margin of the maxillary first molar segment, comprises 70 per cent of the cases. In all cases of this type the pads meet in the region of the molar segments. In Type 2 the relationship is slightly distal, and in Type 3 it is markedly distal. Types 2 and 3 represent 27 per cent and 3 per cent of the cases respectively. In other words, her Type 1 is analogous

to normal occlusion of the adult, Type 2 to distoclusion and Type 3 to marked distoclusion. She made no attempt, however, to assign normality to one type rather than another.

My study was conducted at Bellevue Hospital, an institution restricting its care mainly to indigents. With the exception of two negro babies, all were white and in good health.

TECHNIQUE

A few trial trays were made from a soft metal and, with modeling compound, a number of maxillary and mandibular impressions were taken. Models were poured from which better adapted trays (Fig. 1a and 1b) were prepared. At the start of a series of 20 sets of impressions, observations were made of the relationship of the maxillary and mandibular gum pads as suggested by Clinch. The following day this relationship was again observed on the same group which revealed a wide variation; therefore it became necessary to devise a more exact method for studying the gum pad relationship. After various procedures it was found that the most accurate method was to relate the stone

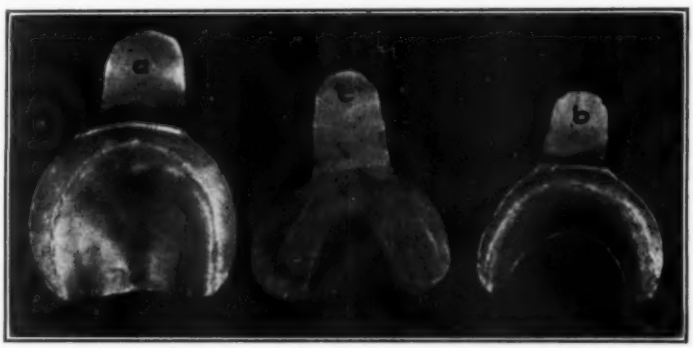

Fig. 1.—Trays for taking impressions of maxillary (a) and mandibular (b) gum pads and bite (c).

casts by means of a bite, consisting of a piece of tray metal sandwiched between two sheets of beeswax (Fig. 1c). Of the 134 individual bites, 20 were duplicates and one a triplicate bite.

The baby was placed in a supine position and the first bite taken only when the infant was in a state of complete repose. The bite could easily be inserted without disturbing the relationship of the jaws. I then pressed the mandible gently, thereby obtaining an imprint of the maxillary and mandibular gum pads in the beeswax. Because of the extent of the bite, the tongue was forced backward. This undoubtedly helped to maintain the actual relationship of the gum pads.

ANATOMY OF THE MAXILLARY AND MANDIBULAR GUM PADS

In Fig. 2 the occlusal view of a set of casts is shown from a 5-day-old baby. The solid lines represent the anatomy that is well marked; whereas the dotted lines represent anatomy that is not clearly defined. The lip groove is on the outer aspect of the arch while the dental groove (a) and gingival groove (b) are on the inner aspect. The dental groove is the result of the

epithelium dipping into the underlying connective tissue; the gingival groove defines the inner alveolar margin. There is a very prominent everted ridge in the mandibular gum pads, generally running between the canine segments. This edge is sometimes observed in the maxillary.

The rugae of the palate are limited to the area within the gingival grooves and run posteriorly to the region of the first molar segment. The incisal papilla, which usually runs to the crest of the ridge, divides the dental and gingival grooves into lateral halves. The frenum labii varies in its attachment; sometimes it starts at the crest to approximately 2 mm. above the crest, while at other times there is a continuity between the frenum and the incisal papilla.

At the suggestion of Dr. Joseph D. Eby to ascertain the frequency of this particular anatomic variation, 185 babies were examined. In 140, or 75 per cent of this group of babies, the frenum labii was not continuous with the incisal

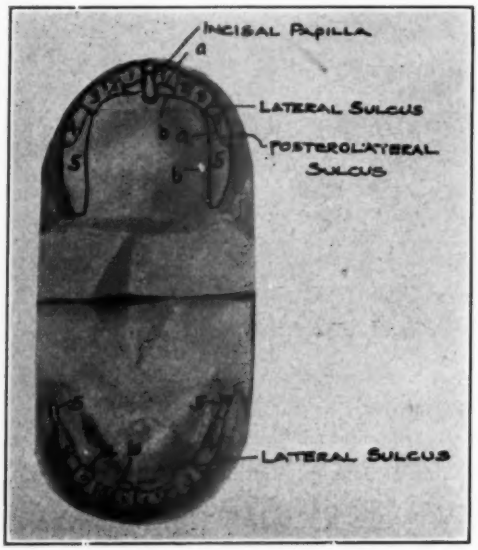

Fig. 2.—Anatomical landmarks of maxillary and mandibular gum pads.

papilla; whereas in the remaining 45 babies, or 25 per cent, a direct continuity between the two seemed to be present. In making this observation tension was exerted on the frenum so that a blanching of this tissue occurred which enabled me to judge its attachment more accurately; otherwise it may be difficult to differentiate between contiguity and continuity. A histologic study would determine the true attachments.

The gum pads are segmented and correspond in number to the underlying deciduous tooth sacs. The division of these segments indicates the position of the interdental septum, with the exception of the posterolateral sulcus. Sometimes the first permanent molar toothsac may be distinguished by a slight elevation which lies distally and lingually to the second deciduous molar segment. In the maxillary, the lateral sulcus runs anteriorly from the lingual to the labial aspects and sometimes extends to a lateral frenum, while in the mandibular this sulcus can be seen on the lingual aspect only. These sulci, which are the anterior margins of the first deciduous molar segments, are consistently

present in both the maxillary and the mandibular gum pads and are well defined. Therefore they serve as landmarks for anatomical evaluation of the relationship of the gum pads.

THE ANTEROPOSTERIOR RELATIONSHIP OF THE GUM PADS

The movement of an infant's mandible is not comparable to that of an edentulous adult. Taking a proper bite in an adult is a difficult procedure. Many prosthodontists have entirely different concepts of correct concentric relationship for the same individual. In the infant, however, the mandible has a definite position when at rest, for the only function required by nature is that of a suckling action and this can be accomplished with little movement of the mandible other than a hingelike motion. This fact can be proved by observation and experimentation.

The exact status of the mutual relationship of the gum pads has not been satisfactorily established. Two anteroposterior dimensions were taken in order to evaluate the relationship of the gum pads: (A) the distance between the

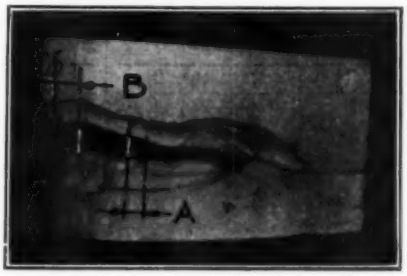

Fig. 3.—Casts showing points of measurements for characters A and B.

maxillary and the mandibular lateral sulci and (B) the distance between the most anterior point of the maxillary and mandibular arches. These dimensions were read to the nearest millimeter with a modified vernier caliper.

The possibility of opening the bite or pressing the mandible distal to its resting position is most unlikely in the newborn. The mandible, however, either may have been closed too much or may have been pulled forward. Both of these suppositions would cause the mandible to be more anterior than its actual resting position. Despite this, it was found that the mandibular gum pads were distal to the maxillary ones in all cases.

TABLE I

DISTRIBUTION OF DISTAL RELATIONSHIP OF THE GUM PADS IN THE NEWBORN INFANT

	SEX	MEAN (MM.)	CHARACTERS A AND B (MM.)								
			0	1	2	3	4	5	6	7	8
For Character A	♂	2.7	1	6	13	12	7	6	1		
	♀	2.5	6	7	14	11	7	3	1	1	
For Character B	♂	4.5			2	5	17	5	7	7	1
	♀	4.1			5	11	18	7	4	3	1

The distribution of this distal relationship is given in Table I. It is noted that the greatest frequency occurs in both male and female when character A is equal to 2 mm. The mean of this character for the male, however, is 2.7

mm. and 2.5 mm. for the female. Character A has a spread from 0 to 6 mm. for the male and 0 to 7 mm. for the female. The greatest frequency for character B is found at 4 mm., although the mean for the male is 4.5 mm. and the female is 4.1 mm. This character ranges from 2 to 8 mm. for both sexes.

Table II gives dimensions of characters A and B for bites No. 1, No. 2, and No. 3 taken on the same baby. The purpose for taking these multiple bites was to check the accuracy of this technique. In nine instances there is an exact check for character A. In nine other babies there is a difference of 1 mm., while in the two remaining cases there is a 2 mm. difference. It is possible that these variations may be due to errors in technique; though there is no reason to think so. The first bite was taken while the baby's jaws were at rest; whereas the second and third bites were taken after the baby had been disturbed and was moving its jaws; therefore these slight differences may represent the limited anteroposterior movement of the infant's mandible.

TABLE II

CHARACTERS A AND B FOR DIFFERENT BITES

CAST NO.	CHARACTER A		CHARACTER B	
	BITE NO. 1	BITE NO. 2	BITE NO. 1	BITE NO. 2
7	0	1	2	3
27	1	1	3	3
41	0	2	3	5
50	4	4	4	3
56	4	3	7	5
65	1	2	2	3
72	2	2	4	4
75	1	1	-	-
76	5	4	7	7
77	2	3	6	6
78	1	1	5	6
80	4	4	6	6
86	2	2	3	3
87	0	1	2	2
91*	0	1	3	4
97	3	3	4	4
98	3	5	5	7
100	1	2	3	3
102	5	5	7	7
105	2	3	3	3

*Cast No. 91 for Bite No. 3.
Character A = 2 mm.
Character B = 4 mm.

Is there any lateral movement? When the models were articulated, the median line of the maxilla and the mandible coincided in nearly every instance. This leads me to believe that, in general, there is no lateral movement.

Other workers state that the gum pads of the infant are in contact, if not anteriorly, then at least in the posterior region. Fig. 4 shows the head of a stillborn infant, illustrating the tongue resting on the anterior portion of the lower gum pad. There was no point of contact between the maxillary and mandibular gum pads. Fig. 5 shows a lateral x-ray picture of the head of a living 10-day-old infant. Here the tongue is seen resting against the palate with the lips in apposition, and a marked opening between the maxilla and the mandible.

Fig. 4.—Head of a stillborn infant, showing position of tongue.

Fig. 5.—Lateral x-ray picture of the head of a living 10-day-old infant, showing the opening between the jaws.

In ten cases the opening of the jaws at rest was measured at two selected points, one in the subnasal region and the other in the mental region, and were remeasured at the same two points with a bite in place. In all instances, the latter subnasomental dimension measured less. These findings lead to the conclusion that, when the jaws are at rest, the gum pads do not meet.

The space between the anterior segments of the gum pads varies in form which has been classified as follows:

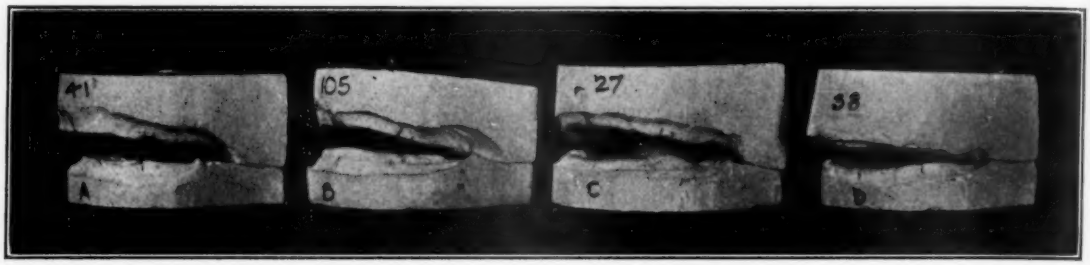

Fig. 6.—Casts illustrating the variations in form of the space between the anterior segments of the gum pads.

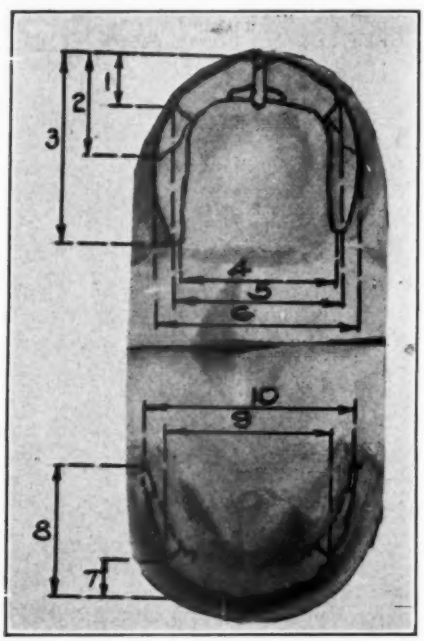

Fig. 7.—Casts showing points of measurements.

Class A. The maxillary and mandibular anterior segments are in parallel planes.

Class B. In the maxillary, the incisal segments are higher than the canine segments while in the mandibular, the anterior segments are in the same plane.

Class C. In the maxillary, the incisal segments are higher than the canine segments while in the mandibular the canine segments are higher.

Class D. In the maxillary, the anterior segments are in the same plane, while in the mandibular the canine segments are higher.

Table III gives the frequency and percentage for these classes. What is the significance of these variations? I am inclined to believe that it is associated with the varying positions of the tooth sacs in the jaws.

TABLE III

CLASSIFICATION OF THE SPACE BETWEEN THE ANTERIOR SEGMENTS OF THE GUM PADS

	CLASS A	CLASS B	CLASS C	CLASS D
Number	33	54	4	1
Percentage	35.8	58.6	4.3	1

There is little information regarding the dimensions of the gum pads in the newborn. Clinch measured casts of the maxillary and mandibular gum pads of 70 infants, and Bakwin measured the maxillary gum pads of 111 infants. My characters were selected so as to compare my findings with those of these workers. The measurements taken were as follows (Fig. 7):

Maxillary Gum Pads.—

1. Length between the labial aspect of the first incisor segments and the labial aspect of the lateral sulci;

2. Length between the labial aspect of the first incisor segments and the buccal aspect at the maximum diameter of the arch;

3. Length between the labial aspect of the first incisor segments and the distal points of the second molar segments;

4. Width of the arches between the distal points of the second molar segments;

5. Width of the arches between the labial aspect of the lateral sulci;

6. Buccal aspect of the maximum diameter of the arch.

Mandibular Gum Pads.—

7. Length between the labial aspect of the first incisor segments and the labial aspect of the extended lateral sulci;

8. Length between the labial aspect of the first incisor segments and the distal points of the second molar segments;

9. Width between the labial aspects of the extended lateral sulci;

10. Width between the distal points between the second molar segments.

11. Depth of the palate at its maximum diameter.

The lengths and widths were measured with a vernier caliper. The depth was measured with a depth gauge. These dimensions were read to the nearest 0.1 mm.

Table IV* presents a list of these characters with their standard deviations (St. D.). For comparison, I have included the corresponding figures of Clinch† and Bakwin. When comparing these figures one must bear in mind that there are two factors that may lead to differences: (1) method of measuring, and (2) judgment. Judgment may vary in locating the labial and buccal aspects, and the crest of the ridge, locating the maximum diameter, and selecting the distal points of the second deciduous molar segments.

*Figures enclosed in brackets indicate number of babies.

†Total averages computed by Sillman.

TABLE IV

COMPARISON OF THE DIMENSIONS OF THE GUM PADS IN THE NEWBORN WITH OTHER INVESTIGATORS

	MAXILLARY LENGTHS						MAXILLARY WIDTHS						MANDIBULAR LENGTHS				MANDIBULAR WIDTHS				DEPTH OF PALATE	
	1		2		3		4		5		6		7		8		9		10		11	
	MEAN	ST.D.	MEAN	ST.D.	MEAN	ST.D.	MEAN	ST.D	MEAN	ST.D.	MEAN	ST.D.	MEAN	ST.D.	MEAN	ST.D.	MEAN	ST.D.	MEAN	ST.D.	MEAN	ST.D.
MALE																						
Bakwin					25.6 (89)	1.60	25.5 (89)	1.20			30.6 (89)	1.50									7.6 (89)	2.00
Sillman	8.6 (44)	0.73	15.1 (37)	1.23	27.7 (42)	1.50	26.3 (42)	1.54	26.3 (39)	1.74	33.8 (37)	1.62	5.4 (44)	0.81	18.6 (38)	1.03	22.9 (41)	1.39	31.3 (36)	1.35	7.6 (48)	0.87
FEMALE																						
Bakwin			13.8 (22)	1.17	25.8 (22)	1.51	26.1 (22)	1.46			30.5 (22)	1.73									8.1 (22)	1.12
Sillman	8.6 (47)	0.62	15.1 (44)	1.27	27.1 (45)	1.26	25.6 (45)	1.41	25.9 (45)	1.37	32.1 (43)	1.34	5.4 (49)	0.75	18.3 (43)	1.58	22.9 (45)	1.59	30.1 (42)	1.45	7.3 (51)	0.86
BOTH SEXES																						
Clinch					21.09 (62)				24.82 (61)		30.29 (61)				17.31 (52)		21.81 (61)				7.42 (61)	
Sillman	8.6 (91)		15.1 (81)		27.4 (87)		25.9 (87)		26.1 (84)		32.9 (80)		5.4 (93)		18.4 (81)		22.9 (86)		30.6 (78)		7.4 (99)	

Table V presents the differences of the various characters. If we make a reasonable allowance because of the method of measuring and the differences in judgment, then Bakwin's figures and mine would agree in most instances. There does, however, seem to be a significant difference for character 3 and possibly 6.

TABLE V

DIFFERENCES BETWEEN INVESTIGATORS OF DIMENSIONS OF THE GUM PADS

DIFFERENCES BETWEEN	SEX	MAXILLARY LENGTHS			MAXILLARY WIDTHS			MANDIBULAR LENGTHS		MANDIBULAR WIDTHS		DEPTH
		1	2	3	4	5	6	7	8	9	10	11
Bakwin and Sillman	♂	–	–	–1.1	–0.8	–	–3.2	–	–	–	–	0
Bakwin and Sillman	♀	–	–1.3	–1.3	+0.5	–	–1.6	–	–	–	–	+0.8
Clinch and Sillman	♂+♀	–	–	–6.3	–	–1.3	–2.6	–	–1.1	–1.1	–	0

At this point one might ask if the varying distal relationships of the gum pads have any effect on the dimensions. For this reason, character A was divided into four groups ranging from (I) 0 to 1 mm., (II) 2 to 3 mm., (III) 4 to 5 mm., and (IV) 6 to 7 mm. Table VI shows the averages corresponding to these divisions, whereas Table VII gives their differences. It is evident that the characters from 1 to 6, which are the dimensions for the maxillary gum pads, vary only slightly for the first two sets of differences.

TABLE VI

DIMENSIONS OF GUM PADS GROUPED ACCORDING TO THE DISTAL RELATIONSHIP

DISTAL RELATIONSHIP / CHARACTER A (MM.)	AGE (DAYS)	BODY WEIGHT (KG.)	MAXILLARY LENGTHS			MAXILLARY WIDTHS			MANDIBULAR LENGTHS		MANDIBULAR WIDTHS		DEPTH
			1	2	3	4	5	6	7	8	9	10	11
(I) 0-1	9	3.33	8.9	15.7	27.3	25.9	26.3	32.5	5.2	17.9	22.4	31.8	7.5
			(17)	(14)	(16)	(16)	(14)	(14)	(16)	(15)	(14)	(14)	(18)
(II) 2-3	8	3.45	8.8	15.6	27.4	26.1	26.0	32.7	5.5	18.7	23.1	30.6	7.2
			(47)	(42)	(47)	(47)	(44)	(42)	(48)	(43)	(45)	(41)	(49)
(III) 4-5	9	3.28	8.5	15.3	27.4	25.8	26.2	32.7	5.2	18.5	23.1	30.5	7.8
			(24)	(22)	(22)	(22)	(24)	(22)	(24)	(18)	(22)	(17)	(23)
(IV) 6-7	8	3.30	7.9	15.3	28.1	24.1	24.9	31.4	6.2	19.3	22.4	29.6	7.4
			(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(3)

TABLE VII

DIFFERENCES OF DIMENSIONS BETWEEN THE VARIOUS DISTAL RELATIONSHIP OF THE GUM PADS

DIFFERENCES BETWEEN	MAXILLARY LENGTHS			MAXILLARY WIDTHS			MANDIBULAR LENGTHS		MANDIBULAR WIDTHS		DEPTH
	1	2	3	4	5	6	7	8	9	10	11
I and II	0.1	0.1	–0.1	–0.2	0.3	–0.2	–0.3	–0.8	–0.7	1.2	–0.3
I and III	0.4	0.4	–0.1	0.1	0.1	–0.2	0	–0.6	–0.7	1.3	–0.3
I and IV	1.0	0.4	–0.8	1.8	1.4	1.1	–1.0	–1.4	0	2.2	0.1

The dimensions, however, for the mandibular gum pads present a different picture. Character 8, which is the length of the arch, varies directly with

character A. There is an increase of 0.8 mm. between groups I and II and 0.6 mm. increase between groups I and III. Character 9, which is the width of the anterior part of the arch, also varies directly with character A, for there is 0.7 mm. increase for groups I and II, and groups I and III. Character 10, which is the posterior width of the arch, varies inversely with character A. There is a decrease of 1.2 mm. between groups I and II, and a decrease of 1.3 mm. between groups I and III. In other words, with increased distal relationship of the mandible, the length and the anterior width are increased while the posterior width is decreased. The last set of differences (groups I and IV) will not be considered because there are only three babies in group IV. It will be noted, however, that the majority of the figures do show differences for the maxillary and mandibular gum pads.

From these figures it would appear that the mandibular gum pads may be affected with an increase in distal relationship of the mandible. It may be that in cases where the distal relationship is greatest, the mandible moves forward or grows forward more rapidly than in those cases where the distal relationship is less, until normal relationship is established. Coinciding with this phase of growth and development, the rate of growth may vary so as to compensate for the dimensional differences. On the other hand, we may be dealing with actual deformities and nature may never compensate for these differences. I shall continue to follow these cases in order to try to determine what actually does happen.

Is birth trauma a factor in the etiology of malocclusion? In general, obstetricians agree that babies delivered with instruments are apt to suffer more trauma than those delivered spontaneously. However, a long hard labor with spontaneous delivery may traumatize the baby more than a short labor with

TABLE VIII

DIMENSIONS OF GUM PADS GROUPED ACCORDING TO TYPE OF DELIVERY

GROUP	TYPE OF DELIVERY	AGE DAYS	WEIGHT KG.	MAXILLARY LENGTHS			MAXILLARY WIDTHS			MANDIBULAR LENGTHS		MANDIBULAR WIDTHS		DEPTH
				1	2	3	4	5	6	7	8	9	10	11
I	Elective cesarean	6	3.59 (3)	8.1 (2)	15.3 (2)	28.1 (2)	27.4 (2)	26.8 (2)	33.7 (2)	5.3 (3)	18.1 (3)	23.4 (3)	30.5 (3)	7.7 (3)
II	Spontaneous vertex presentation	8	3.45 (89)	8.6 (79)	14.9 (70)	27.3 (75)	26.0 (75)	26.0 (73)	32.9 (69)	5.3 (79)	18.4 (69)	22.9 (74)	30.6 (66)	7.4 (85)
III	High or low forceps	8	3.41 (10)	8.7 (8)	15.9 (7)	27.6 (8)	25.7 (8)	26.1 (7)	32.6 (7)	5.7 (9)	18.9 (9)	22.8 (8)	30.7 (9)	7.2 (9)
IV	Spontaneous face presentation	9	3.41 (2)	7.9 (2)	16.7 (2)	26.7 (2)	23.2 (2)	24.6 (2)	31.4 (2)	5.4 (2)	–	24.2 (1)	–	7.8 (2)

instrumental delivery skillfully performed. Eliminating this exception to the rule, the averages of the various measurements of the maxillary and mandibular gum pads have been classified into four groups, according to the probable degree of trauma to which the baby was subjected during birth (Table VIII):

Group I, elective cesarean section;

Group II, spontaneous deliveries with vertex presentation, with the exception of one breech presentation;

Group III, vertex presentations delivered with high and low forceps; and

Group IV, spontaneously delivered face presentations.

TABLE IX

DIFFERENCES OF DIMENSIONS GROUPED ACCORDING TO TYPE OF DELIVERY

DIFFERENCES BETWEEN	1	2	3	4	5	6	7	8	9	10	11
I and IV	0.2	-1.4	1.4	4.2	2.2	2.3	-0.1	-	-0.8	-	-0.1
II and III	-0.1	-1.0	-0.3	0.3	-0.1	0.3	-0.4	-0.5	0.1	-0.1	0.2

Table IX shows the differences of the averages between groups I and IV, and II and III. If the averages for the latter two groups, comprising 89 spontaneous and 10 forceps deliveries, are compared, their differences in the meas-

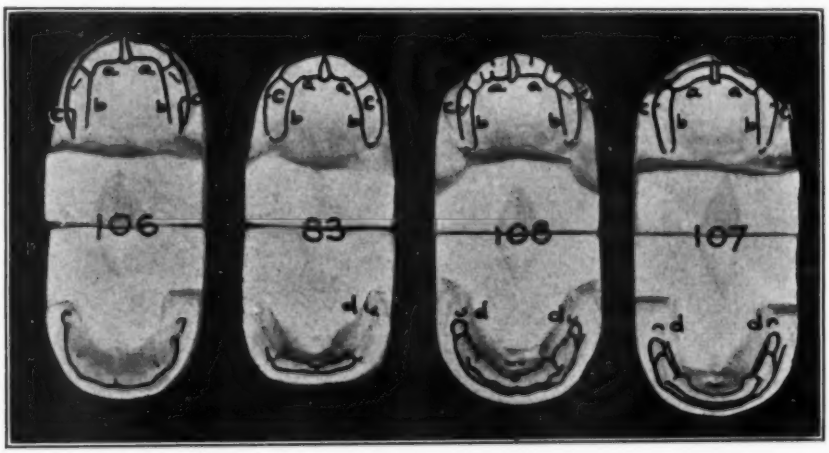

Fig. 8.—Occlusal views illustrating the variation of arch form in the newborn.

Cast No.	106	83	108	107
Sex	Female	Male	Female	Female
Age (days)	3	10	11	9

All were white and spontaneously delivered vertex presentations. Three different forms of the outer alveolar margin are presented: (1) 106, (2) 83 and 108 which are similar in form, (3) 107. The position of the maximum diameter (c) is relatively most distal for 106, least distal for 107, and in-between for 83 and 108. The inner alveolar margin or gingival groove (a and b) seems to bear no relationship in form to the outer alveolar margin, for the inner margins of 106 and 83 are similar; i.e., flat anteriorly (a) with diverging lateral arms (b), while the lateral arms for 108 and 107 are parallel, but the anterior portion (a) is flat for 108 and curved for 107. In the mandibular the outer alveolar margin for casts 106, 108 and 107 conforms to an arc of a circle while the arc is flattened anteriorly for 83. The location of the first permanent molar tooth sacs is designated by d.

urements are so small that it appears as if instrumental delivery had no effect on the dimensions of the gum pads. Elective cesarean sections (group I, where the baby's face suffers no trauma) and face presentation deliveries (group IV, where the greatest degree of trauma to the face is experienced) are relatively infrequent; therefore there are only a few such cases for each group. Although the cesarean section babies included in this series happen to have weighed more than those delivered with face presentation, it is interesting to note that a comparison of most of the characters in these two groups shows considerable difference. A larger number of cases with a careful follow-up would undoubtedly lead to a more certain conclusion.

Fig. 9.—Casts illustrating variations in position of tooth sacs.

Cast No.	77	114	75
Sex	Male	Male	Male
Age (days)	6	4	10
Color	White	White	Negro

Of the 709 infants observed, these 3 babies showed their physiologic development to be in advance of their age, as evidenced by the early eruption of the tooth sacs. In casts 77 and 75 the maxillary first incisor tooth sacs (t) are partially erupted. It is of interest to note the flattening of the anterior portion of the ridge in cast 77. Also note the unusual cleft between the first incisors in cast 75. In the mandibular cast 114, one of the erupted incisor tooth sacs (t) is rotated.

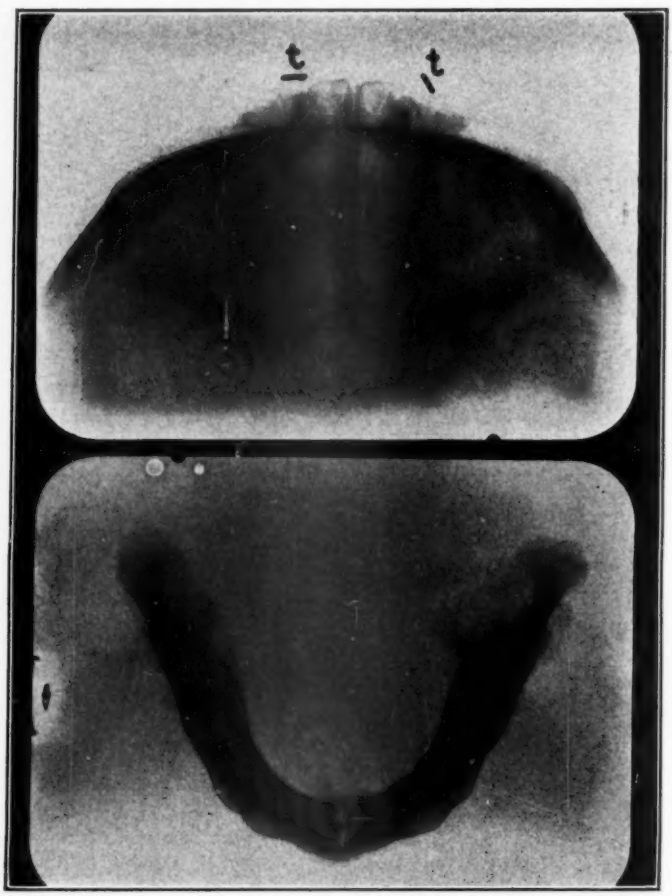

Fig. 10.—Occlusal x-ray picture of a stillborn infant, showing variation of position of the maxillary second deciduous incisors. There is symmetry of position in the mandibular incisors but asymmetry of position in the maxillary second incisors, one being rotated.

SUMMARY

A careful study of a group of 709 infants ranging in age from 1 to 11 days, leads to the following:

1. In order to determine accurately the relationship of the gum pads, casts must be made and articulated by means of a bite.

2. The gum pad of the mandible is distal to the maxilla in all cases on an average of 2.7 mm. in the male and 2.5 mm. in the female.

3. The range of variation of this distal relationship is from 0 to 7 mm.

4. There is a limited anteroposterior movement of the mandible but no lateral movement.

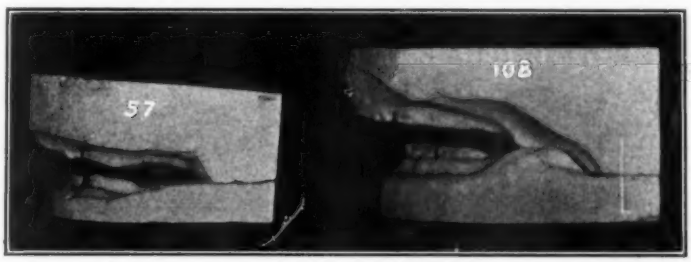

Fig. 11.—Lateral views illustrating the range of variation of the distal relationship of the gum pads. The vertical lines in the maxillary and mandibular casts represent the position of the lateral sulci.

Cast 57	Character A	0 mm.
Cast 108	Character A	7 mm.

Fig. 12.—Casts of a pair of identical male twins, 5 days old, white.

Twin No. 1	Twin No. 2
6 pounds, 3 oz.	5 pounds, 12 oz.
Spontaneous vertex delivery.	Single footling delivery.

Although the weight and deliveries were different, all dimensions of their casts were practically identical.

5. When the jaws are at rest, the gum pads do not meet.

6. The space between the anterior segments of the gum pads varies in form.

7. With an increased distal relationship of the jaws the dimensions of the mandibular gum pads seem to be affected. The length and anterior width show an increase, while the posterior width shows a decrease.

8. Comparison between spontaneously delivered babies and those delivered instrumentally shows little difference in the dimensions of the gum pads. Babies delivered by elective cesarean section compared with those with face presentation do, however, show appreciable dimensional differences.

I wish to express my appreciation to Dr. Charles Hendee Smith, to Dr. William E. Studdiford, and to Dr. Leo Winter, who made it possible for me to carry out this work in their respective departments at Bellevue and my thanks to Dr. Harry Bakwin for his many suggestions and for giving generously of his time and experience.

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667 MADISON AVENUE

CONGENITAL CONSTITUTIONAL FACTORS IN DEFECTIVE DENTAL DEVELOPMENT

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JUDGING from the literature relating to dental abnormalities in children, it would appear that both physicians and dentists stress the immediate conditions surrounding dental defects, with scanty reference to congenital constitutional agencies that may profoundly affect tooth development. Our clinical observations of many hundreds of children in whom an appraisal of the teeth has been included in the examination leads us to believe that nutritional agencies, dental hygiene, blood serum calcium content, and idiopathic bodily disorders play a rôle important but secondary in many instances to a fundamental constitutional dyscrasia as a cause of the early pathologic conditions of teeth, irregularities in placement, malocclusion, and the absence of the tooth buds.

It is to this group I wish particularly to call attention. In four well-known congenital body disorders the teeth stand out prominently, a peculiarly sensitive index to physical developmental processes.

In hereditary ectodermal dysplasia there is the absence of complete tooth development, missing teeth or irregularities in placement or absolute failure of the teeth to appear.

In mongolism the teeth are tardy in appearing, structurally defective, and irregular in time of appearance and placement. Among hundreds of these unfortunates I have never found normal dental development. There are different grades of mongolian dyscrasia—in a few cases it has been difficult to determine the dividing line between mongolism and normalcy.

Both in syphilis and in thyroid deficiences the extremes may be represented as regards the degree of involvement. In syphilis the embryo may go to term or sterility may occur. From these pronounced effects there is the very mild syphilitic infection of such a nature that a positive diagnosis is difficult without the Wassermann or Kahn test, and the most remote effects may be indicated only by defective growth or errors in bodily development. Hutchinson's teeth may be the only suggestion of congenital syphilis.

In the hypothyroid, the extreme is represented in the cretin in whom there is an absence of the gland or greatly disturbed function with resulting dwarfism and other characteristic stigmas, including every type of tooth anomaly. Among the remote effects the dental processes may be the most conspicuous sign, including faulty structure, irregular placement, late appearance, and early decay. Coincident with the late appearance of the teeth we find not infrequently a spread of from two to five years between the chronologic

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and the bone age. The delayed bone age we find associated with late tooth eruption, placement irregularities with crowding, and early decay and loss of the teeth. Engelbach writes as follows: "Among forty-three cases of juvenile thyropituitarism eighteen showed orthodontic changes such as overcrowding, malposition, defective calcification with decay of the teeth."

The family history of dental disorders in children carries with it the suggestion of a constitutional ailment. In the vast majority of parents of children with defective teeth, inquiry and examination showed that the child was carrying on the familial defect. When a group of children show a profound selective pathologic tooth condition of a known etiology, as in the case of cretinism, it is logical to assume that a lesser manifestation of the stigma might be a sensitive index, perhaps the remotest indication of the disability and without other signs of physical derangement. In this connection it is fair to assume that dental errors of development in the young may be due in part to a systemic endocrine deficiency with failure to produce and maintain a tooth structure capable of resisting the various agencies that may prove destructive. It is our belief that dental anomalies may be prevented in many children through recognition of mild endocrine defects in the parents and the introduction of suitable treatment at the onset of pregnancy, similar in principle to the management of the syphilitic mother.

When the thyroid gland is better understood, I prophesy that it will be found that it possesses possibilities of varying functional capacity in different individuals or in the same individual at different life periods under varying conditions not appreciated at the present time. Like the hypophysis, the thyroid will be found to possess selective hormonal activities operating independently upon different body functions or in association with other endocrine products. The only explanation of the results of thyroid gland therapy on the osseous system of the child is that the gland supplies a growth fraction variable in its potency and independent of other hormones with a selective action on the hypophysis and probably the gonads. Children who have had successful orthodontic treatment with normal replacement should be kept under observation for a period of years; the hypothyroid state is persistent, and normalcy in position and structure of a tooth might not be maintained without replacement therapy.

A great deal of stress both by dentists and physicians relates to the serum blood calcium in defective dental development. Among a series of 294 children in whom blood chemistry determinations were carried out in our laboratory 48 came because of defective teeth with the suggestion by the referring dentist or physician that "the child has soft teeth, early decay, defective enamel, apparently suffering from a lowered lime content in the circulating blood medium." In these 48 patients the age ranged from five to fifteen years. Looking upon the normal calcium as 9 mg. of calcium in 100 c.c. of serum as the low normal for children, 46 of these patients had normal serum calcium.

In a boy of 13 years the calcium content was 8.963 mg. to 100 c.c. of serum; another boy 10 years of age had a calcium content of 8.936 mg. In both, there was a mathematical deficiency, not of any clinical significance.

These 48 patients were not children with a filled cavity or two; they had gross lesions, as is evidenced by the fact they were referred by dentists and family physicians for calcium determinations. It is evident that in these children factors were present for the dental abnormalities other than the calcium content in the blood serum, which serves simply as a transportation medium between the gut and the osseous system and from there to the kidneys and gut for excretion.

A considerable group with similar complaint which we have seen since the above statistics were compiled bear out our previous findings that it is not a deficiency of lime in the circulating medium but a constitutional deficiency frequently of an endocrine nature which establishes and carries out the proper deposition of calcium and the timely eruption of the tooth. The general acceptance of the calcium imbalance theory in dental caries by dentists and physicians encouraged by proprietory agencies to enhance the popularity of calcium and phosphorus products led the Council on Dental Therapeutics to undertake an investigation as to the relation between calcium and phosphorus intake and dental defects in the developing human being. The Council pointed out that there is no direct positive evidence from either the laboratory or the clinic that the addition of calcium and phosphorus compounds to an otherwise ample diet influenced in any definite matter the incidence of dental detail in the child or in the adult or that it promoted the development of noncarious teeth in utero, in infancy, or during growth in the adult; nor is there any sound evidence that a calcium drain during pregnancy and lactation is lessened by the addition of these compounds when the mother's diet is well balanced. The Council concludes, "There is no carefully controlled evidence that the addition of calcium and phosphorus compounds, whether inorganic or organic, promote retention of these elements and hence freedom from dental diseases, except in known cases of deficiency. Where this occurs, milk serves as an excellent source of calcium and phosphorus in a readily assimilable form.

"There is no evidence that the ingestion of combinations of calcium and phosphorus in addition to diets adequate in these elements promotes the development of sound teeth in the human fetus. The calcification of the teeth is a postnatal event."*

In closing, I wish to state that I have always worked in close contact with members of the dental profession. I have found this greatly to my advantage —we need you and perhaps I may have said something in the above contribution that will emphasize the fact that you need us.

132 West Eighty-First Street

*Editorial, J. A. M. A., May 8, 1937.

EFFECT OF X-RAYS ON THE DEVELOPING TEETH OF RATS

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THE knowledge that Roentgen rays may have an injurious effect upon the cell if given in large enough doses came along with its use as a diagnostic aid in medicine and dentistry. A vast amount of research has been carried on to determine the effect of various doses on the cells. Most of this research has been done by the medical profession. They have shown that the untoward effects of irradiation are usually acute and in the form of either burns and epilation, as a result of excessive dosage, or of acute constitutional symptoms; namely, malaise, lassitude, and loss of appetite.

In 1925 Leist[1] of Vienna made a study of the effect of Roentgen rays on the teeth. The possibility that Roentgen rays had an effect on tooth structures was called to his attention by the following case. A young man who worked in a Roentgen tube factory as a tube tester was daily exposed to great amounts of the rays. After six months, he had lost considerable weight; he complained of tiredness and lost great quantities of hair while combing it, symptoms which pointed toward Roentgen ray injury. Previous to this time he had never had trouble with his teeth; now they, too, began to give him trouble. Suddenly, a swelling appeared in the region of the maxillary left lateral incisor with subsequent fistula formation. The patient had had no symptoms of pulpitis previous to that. One by one the other teeth began to abscess.

A vitality test showed that twelve apparently intact teeth were not susceptible to a weak Faraday current; eleven did not give a reaction to a medium Faraday current, and three gave no reaction at all. The injury had occurred within a comparatively short time in a mouth apparently not susceptible to caries, in the form of multiple destruction of the pulp. This destruction had taken the form not of pulpitis but of a noninflammatory disintegration of the pulps. The necrotic pulp became infected later on, probably by way of the blood stream. Leist thought that the Roentgen rays had caused the death of the pulp. Roentgen ray experts denied this, saying that if this really were a case of Roentgen ray burn, the patient should show some skin lesions or disturbance of the glandular elements of the mucous membrane, and the submaxillary and parotid glands. In the light of this, Leist undertook the following investigation:

Eight rats were exposed to the Roentgen rays, which were directed against the frontal aspect of the head. The distance of the tube from the skin surface was 28 cm., the voltage 120 kilovolts and the current 2 milliamperes.

From the Department of Histology, Northwestern University Dental School.
Presented to the American Board of Orthodontia.

Leist's dosage was figured in Holzknecht units. Sixty seconds of exposure would be necessary to produce one Holzknecht unit with a regulation dental x-ray machine which has a spark gap of 3 inches and a current of 10 milliamperes with a target skin distance of 7 inches. The dosage was given as shown in Table I.

TABLE I

DOSAGE (HOLZKNECHT UNITS) IN LEIST'S EXPERIMENT

RAT	DOSE OF 15 H	
	GROUP 1	
1	1	
2	4	April 26–June 7
3	4	April 26–June 7
4	5	April 26–June 14
5	6	April 26–May 31
	GROUP 2	
RAT	EXPOSURES	
6	8	(5 doses 1.5 H, May 3–June 21 3 doses 15 H)
7	9	(6 doses 1.5 H, May 3–June 27 3 doses 15 H)
	GROUP 3	
RAT	EXPOSURES	
8	9	(1.5 H, May 3–June 27)

All of Leist's rats showed the same histologic picture. The teeth of the animals exposed showed interrupted dentin formation and degeneration of the odontoblasts. The calcified layer of dentin was abnormally thin; notchlike depressions occurred on the pulp surface of the dentin, and over the thin calcified dentin was disposed a rather heavy layer of dentinoid tissue; that is, uncalcified dentin. A row of very degenerated odontoblasts was associated with this uncalcified dentin. Between the layer of calcified dentin and the dentinoid tissue there sometimes occurred a row of degenerated odontoblasts which, in an almost uninterrupted line, separated the calcified and the uncalcified tissue. The contour of the dentin was very irregular in the region of the notchlike depressions. No abnormalities could be observed in the enamel. Where the exposures were of lesser strength, the signs of injury were much less.

It was interesting to note that the Roentgen rays had a selective effect on the odontoblasts among all the dental tissues. Leist notes that this fact corresponds well with the statements of Ranzi and Salis, who say that Roentgen rays have a more pronounced effect on the mesodermal tissues of the oral cavity to which the odontoblasts and pulp belong, than on the epithelial tissues.

This injury was only a temporary one when a dose of 15 H unfiltered rays was given, as within a week after the effect of the rays had been noted the tooth resumed its growth even though the new growth was somewhat smaller than what normal growth would have afforded. Nothing abnormal could be

detected in the odontoblasts of the newly grown portion. Thus, the incisors of the rat seemed to be susceptible to the influence of the Roentgen rays, but the influence was only a passing one.

The results of Leist's work, which show that an injury may be produced in a tooth by Roentgen ray irradiation, present a problem of practical interest to the dentist. Roentgenograms of all of the teeth are often necessary in the practice of children's dentistry. This is always necessary before starting the treatment of a case of malocclusion. At the time that these roentgenograms are taken, a large percentage of the permanent teeth are in a formative stage. It is, therefore, important to know whether the amount of exposure experienced by a child in having a full mouth dental Roentgen ray examination has an injurious effect on these developing teeth.

Leist's work does not cast any certain light on this problem, for his individual exposures as well as his cumulated dosage are far too high to be comparable with the exposures necessary for full mouth or repeated roentgenograms. Therefore, it was thought highly desirable to undertake the problem of determining whether an injury could be produced in the developing tooth by a series of Roentgen ray exposures that a child might be subjected to in securing dental films. Experimental work was therefore undertaken along this line.[2]

Six rats of the same litter were used in carrying out this work. Five of them were exposed to the Roentgen rays when but six days old. The other rat, which was not exposed, was used as a control. Rats were chosen because of their incisor teeth having persistent pulps, which assured a developing condition that might be altered by the rays. Young rats were used to make possible an examination of the root development of the molar teeth (not having persistent pulps) for the effect of the Roentgen rays.

The rats were exposed to a series of irradiations that was thought to correspond to the individual exposures or repetitions of exposures to which a child might be subjected in securing dental roentgenograms. They were exposed to the rays over a period of three weeks (Table II).

TABLE II

PERIODS OF EXPOSURE (AUTHOR'S EXPERIMENT)*

RAT	TIME (SECONDS)	TIME PER WEEK
2	5	3
3	5	6
4	10	6
5	20	3
6	20	6

*Target skin distance, 7 inches; milliamperage, 10; spark gap, 3 inches.

The Roentgen ray technique was planned and carried out in such a manner that the rats were exposed to the central portion of the rays at each irradiation. Each rat was held in position so that the strong central rays were directed on the mouth, the teeth and the jaws receiving the maximum amount of the rays at each exposure. In consideration of the fact that the bone in the present investigation was that of very young rats, the penetration of the rays could not have been greatly interfered with.

Ten days after the last irradiation, the rats were killed with ether and prepared for sectioning. Zenker's solution was used as a fixing agent. From the heads, which were prepared and blocked in celloidin, serial sections were cut transversely. Hematoxylin and eosin were used for staining.

A careful study was made of all sections for defects in the formation of the tooth substance. The dentin and the odontoblastic layer were studied particularly for notches and defects as described by Leist. The roots of the molars as well as those of the incisors were studied for such defects.

A thorough study of transverse serial sections of the jaws and teeth of the rats thus revealed no structural defects. The odontoblastic layer and the pulp were normal throughout. The dentin was well formed and regularly calcified. The photomicrographs (Figs. 1 and 2) of the control rat and the

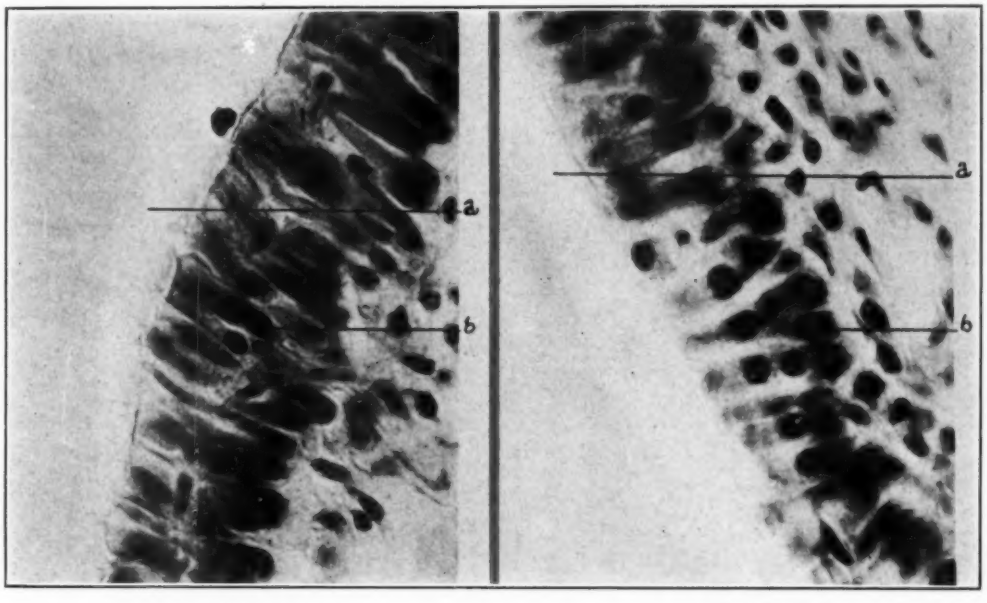

Fig. 1. Fig. 2.

Fig. 1.—Control rat. Odontoblasts under high power: *a*, dentin; *b*, odontoblasts.
Fig. 2.—Irradiated rat. Odontoblasts under high power: *a*, dentin; *b*, odontoblasts.

rat having had the greatest exposure clearly bear out the foregoing statement. Sections taken from the same level of the jaws and teeth of the control rat and of any of the irradiated rats resemble each other just as closely as do the photomicrographs shown.

The difference in the results of this investigation and those of Leist was due, no doubt, to the difference in dosage. It was decided, therefore, to make an additional study using greater dosages to determine whether an effect

TABLE III

PERIODS OF EXPOSURE (AUTHOR'S EXPERIMENT)

RAT	TIME (MINUTES)	TIMES PER WEEK
1	5	3
2	10	1
3	2	3

could be produced with the dental x-ray equipment and to determine how much exposure would be necessary to get such an effect.

Four rats of the same litter were used to carry on this additional work. Three of them were exposed to the x-ray when six days old. One was used for a control. The x-ray was administered as reported in Table III.

Fig. 3. Fig. 4.

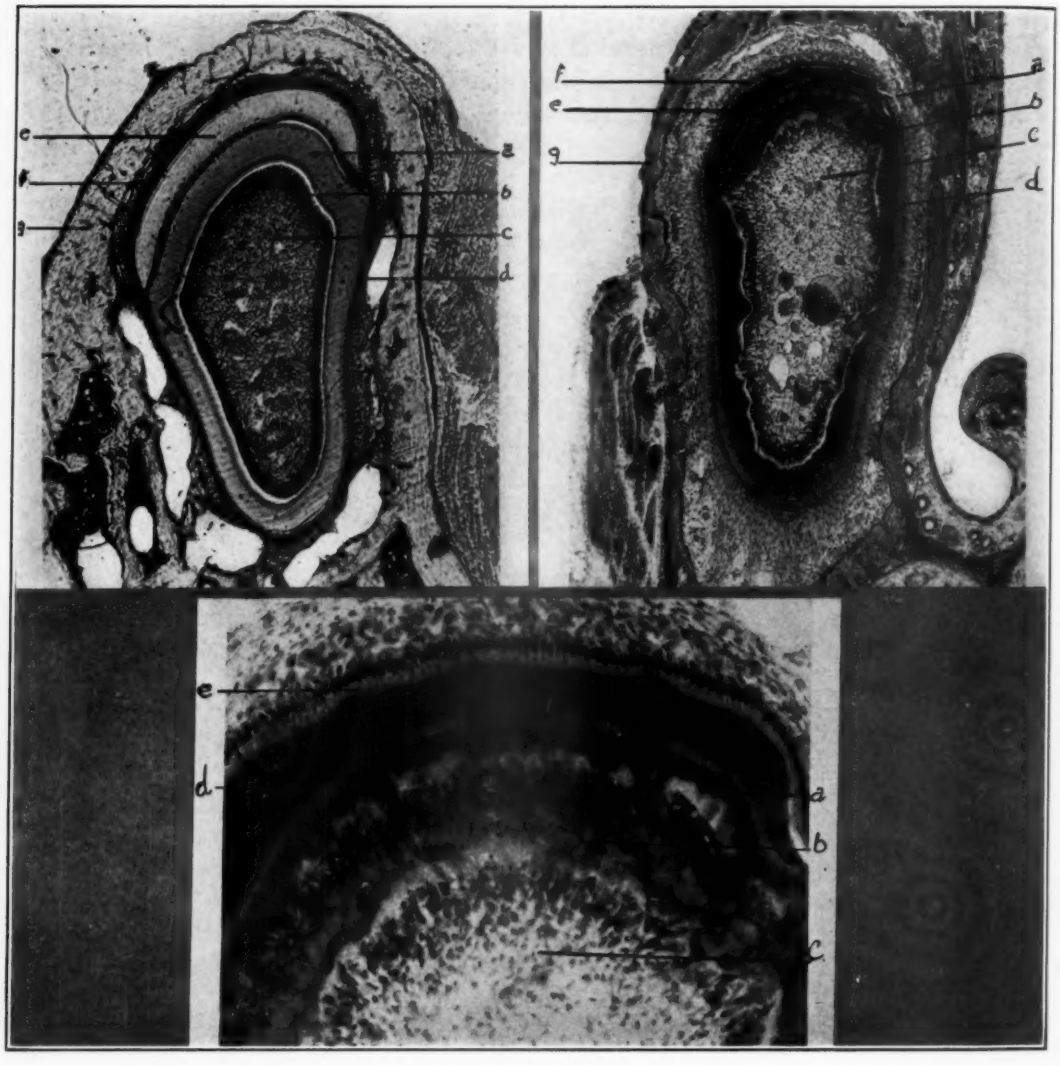

Fig. 5.

Fig. 3.—Control rat. Various tissues of the tooth as seen under low power: *a*, dentin; *b*, odontoblasts; *c*, pulp; *d*, p.d.m.; *e*, enamel; *f*, enamel epithelium; *g*, bone.

Fig. 4.—Rat No. 1. Various tissues of the tooth as seen under low power: *a*, dentin; *b*, odontoblasts; *c*, pulp; *d*, p.d.m.; *e*, enamel; *f*, enamel epithelium; *g*, bone.

Fig. 5.—Rat No. 1. Various tissues of the tooth as seen under high power: *a*, dentin; *b*, odontoblasts; *c*, pulp; *d*, enamel; *e*, enamel epithelium; *f*, bone.

The exposure was made using the same x-ray machine and in the same manner as in the first experiment.

Rat No. 1, therefore, received a cumulative dosage of 15 H in one week's time, rat No. 2, 10 H, and rat No. 3, 6 H.

Ten days after the last irradiation the rats were prepared for sectioning. Rats No. 1 and 2 showed many symptoms of overexposure to x-ray. They lost all the hair on their heads and backs. They were inactive and ate very little food. Rat No. 3 seemed normal in all respects. All rats weighed approximately 8 grams when the first irradiation was given. When prepared for sectioning, rat No. 1 weighed 24 grams; rat No. 2, 34 grams; rat No. 3, 40 grams; and the control rat 38 grams. Rats No. 1 and 2 showed an apparent lack of development.

The incisors and molars of all rats were studied for defects in structure. Rats No. 1 and 2 showed a very decided disturbance in the dentin of the incisors. The effect in rat No. 1, which received the most irradiation, was more pronounced than that in rat No. 2. In the former, the dentin was dis-

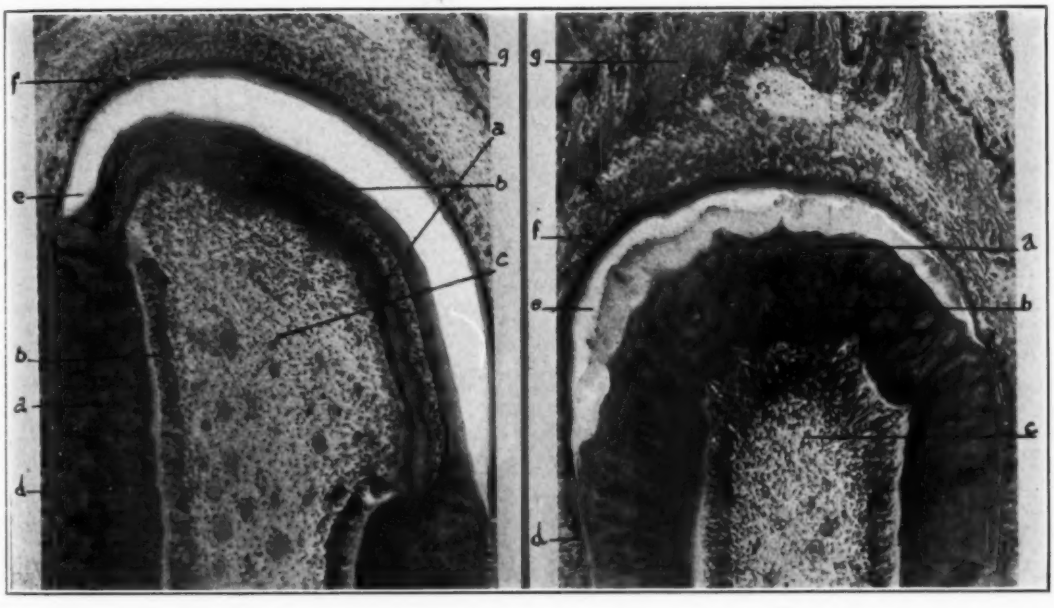

Fig. 6. Fig. 7.

Fig. 6.—Rat No. 2. Various tooth tissues as seen under high power: *a*, dentin; *b*, odontoblasts; *c*, pulp; *d*, p.d.m.; *e*, enamel; *f*, enamel epithelium; *g*, bone.

Fig. 7.—Rat No. 2. Another section under high power showing irregular dentin formation on enamel side: *a*, dentin; *b*, odontoblasts; *c*, pulp; *d*, p.d.m.; *e*, enamel; *f*, enamel epithelium; *g*, bone.

organized throughout the entire section. Notch-like depressions occurred on the pulp side, and there seemed to be a disturbance in calcification throughout. The odontoblastic layer was completely disarranged. The odontoblasts seemed to be broken into groups which were scattered around between calcified areas in the dentin. The calcified layer of dentin was abnormally thin. The other tooth tissues seemed normal, and thus it was apparent that the x-ray had a selective effect on the odontoblasts. This effect was only temporary, however; for in following through the sections the abnormality was apparent on only a few serial sections and then disappeared entirely. It is probable that only the area undergoing development at the time of exposure was affected. This effect was noticed in both maxillary and mandibular incisors (Figs. 3, 4 and 5).

Rat No. 2 showed the same effect only in a lesser degree. The effect here was apparent in the dentin on the enamel side. This effect, too, was present in both maxillary and mandibular incisors and disappeared after a few serial sections (Figs. 6 and 7).

Rat No. 3 seemed perfectly normal throughout.

A study of the molars of the irradiated rats showed only one defect. That appeared in the serial sections which showed the developing last molar in rat No. 1. The effect was very similar to the effects shown in the incisors (Fig. 8).

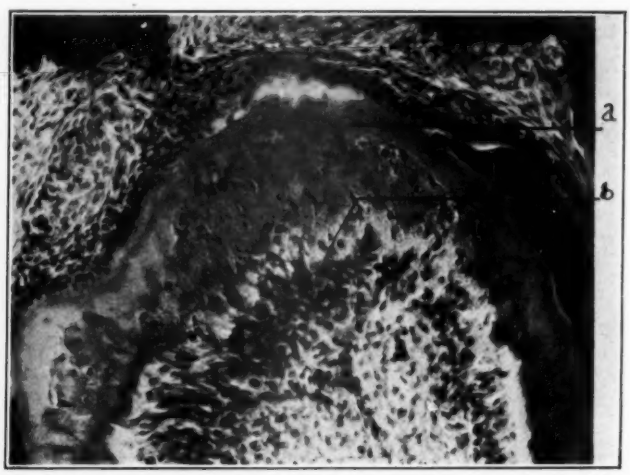

Fig. 8.—Rat No. 1. Section of developing last molar tooth under high power: *a*, dentin; *b*, odontoblasts.

SUMMARY

1. No disturbance was found in any of the structures except the odontoblasts and the dentin.

2. Dosages of the x-ray given in individual dosage comparable to those used in dental radiography, as shown in Table II, did not cause any defects in the dentin of any teeth of the rats.

3. Greater dosages, as shown in Table III, caused a definite disturbance in calcification of the dentin.

4. This effect was only temporary, and it is probable that only the area undergoing development at the time of exposure was affected.

5. The effects shown in using greater dosages seem to compare favorably with those shown by Leist in his investigation.

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MYOFUNCTIONAL THERAPY IN THE TREATMENT OF A CLASS III CASE OF MALOCCLUSION

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IN PRESENTING this case report, it is not my purpose to outline a definite procedure in the treatment of malocclusion, but rather to illustrate what might be accomplished in certain cases by the use of myofunctional therapy.

This was a Class III case of malocclusion which was treated by the use of myofunctional therapy, with minor mechanical assistance.

Fig. 1. Fig. 2.

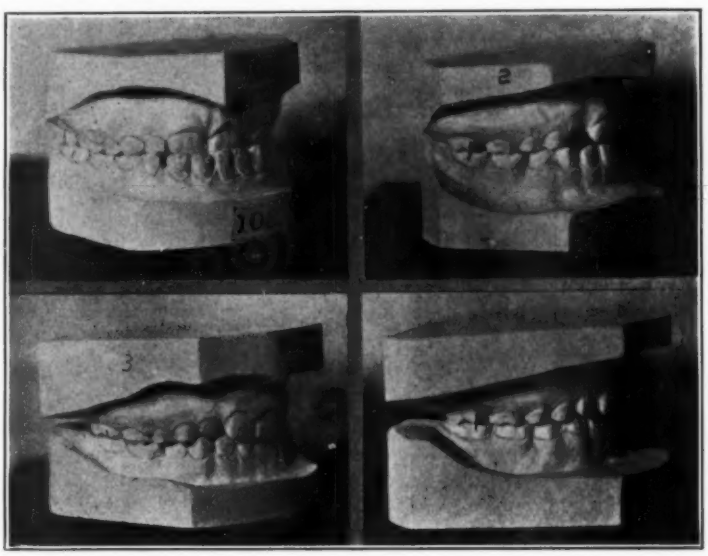

Fig. 3. Fig. 4.

The patient, a girl nine years of age, upon examination presented a definite mesioclusion. The malrelationship was recognized as progressive and in its early stage.

Fig. 1 shows the case at the beginning of treatment. It will be noticed that both the maxillary and the mandibular arch are fairly well formed, and the individual teeth are also in fairly good alignment. (This is important, since if this condition was not present, it would have been necessary to secure arch form and tooth relationship before starting myofunctional treatment.)

It was found that with effort the patient could retract the mandible to a position which would allow the anterior teeth to bite just in edge-to-edge relationship, and at this stage the child was taught to retract the jaw to this point, and contract and relax the masseter-temporal muscles, thus combining a pterygoid and masseter-temporal exercise.

Read before the New York Society of Orthodontists, New York, N. Y., Nov. 16, 1937.

Fig. 2 shows the case after two months of myofunctional treatment. The central incisors had been slightly depressed, which is advantageous in later treatment, and the child had no difficulty occluding in this position.

At this stage the actual curve of the maxillary anterior teeth and arch was recorded, and with this knowledge at hand, thin soft wood sticks, similar to throat sticks, were steamed and bent to conform to this curve. The patient was then instructed in the use of these prepared sticks as a means of applying pressure against the mandibular teeth and arch, using the maxillary teeth and arch as a basis of anchorage, and at the same time again practicing the masseter-temporal exercise.

Fig. 3 shows the case two months later. The arches were in an almost normal relationship for the patient's age.

At this stage the continued use of the masseter-temporal exercise in conjunction with a muscle tonic exercise, using a salt and water solution and flushing it back and forth between her teeth, was recommended.

Fig. 4 shows the case just one year after the beginning of treatment. Arches and teeth were in good alignment, with no tendency for a recurrence. I have had this patient under observation during the past year, and the dentition is developing normally.

Since treating this patient, I have found that a flat piece of sponge rubber faced upon both sides, and used in place of the steamed wooden sticks, is more advantageous and allows for a more normal use of the masseter-temporal muscles in treatment.

129 Whitney Ave.

EVOLUTION AND FORMATION OF THE IDEAL ARCH WIRE

LEONARD P. WAHL, D.D.S., WAUSAU, WIS.

OF THE various appliances that operate on the labial and buccal aspect of the dental arches, the oldest is the round expansion or alignment arch, which in crude form was suggested by Pierre Fauchard as early as 1723. Though it has been used in many modified forms, its evolution has been influenced and it has been brought to the highest degree of efficacy by the late Edward Hartley Angle. After developing the "E" arch, Dr. Angle introduced the pin-and-tube appliance in 1910, followed by the ribbon arch in 1915, and finally the edgewise arch which he presented to the Angle Society of Orthodontia in Pasadena, California, in 1926. Relative to the latter development, Dr. Angle informed us that in this mechanism are combined most of the best points of all his former types of expansion arches, and that it has many other distinct advantages peculiar to it of physiologic and dynamic importance.[1]

Briefly, this mechanism consists of the following parts: the edgewise arch wire, 0.022 in. by 0.028 in. in diameter; bracket bands; anchor bands; sheaths, staples, washers, ligatures. Its auxiliary attachments are few; namely, the stop spur, the ligature spur, the intermaxillary hook, the rotating loop, and the vertical loop. This latter auxiliary is sometimes replaced by a small section of 0.010 in. coiled spring material similar to that used by E. B. Arnold of Houston, Texas. (I am grateful to Homer Sheldon of Kansas City for this ingenious idea.)

With this appliance, by measurements of the teeth, allowance for band thickness and necessary bends, a so-called ideal and subsequent typal arch wire is formed, specifically adapted to use on the particular case under analysis, unmodified in the horizontal plane except as is necessary for a margin of safety to produce overdepression, elevation, rotation or axial position of the units individually or in series. By so forming the arch wire, a visible guide or pattern toward which to work is developed, while the teeth will have an active mold to which they can be fitted and adjusted. However, where too great a malocclusion or perversion exists in which the arch wire in this ideal typal form would cause lip irritation and traumatic reaction in the supporting tissues, modifications must be made from this initial form with gradual changes to its original shape as development is accomplished. This situation is ofttimes met with by preceding the edgewise arch wire by a 0.022 in. by 0.022 in. square arch wire or a round arch material of similar or smaller diameter. These, though typal in form, may be engaged or laced in the brackets because of their elasticity, and when brought within the province of the original edgewise arch wire form, it is then inaugurated.

In the older types of appliances, the springs and levers were comparatively long, and successful results depended greatly upon the skill in maintaining suitable anchorage, whereby these levers might find proper fulcra. In this new mechanism, however, through the agencies of bracket bands and sheaths on anchor bands strategically placed on the teeth, these long levers and springs are broken up into series, thereby simplifying the problem of anchorage, for each dental unit serves as an aid in changing the position of every other tooth in the same arch, with less dependency upon the molars as the chief source of anchorage.

This appliance also offers more efficient means of effecting the three orders of tooth movements: first, the labial, buccal, rotational, lingual, depres-

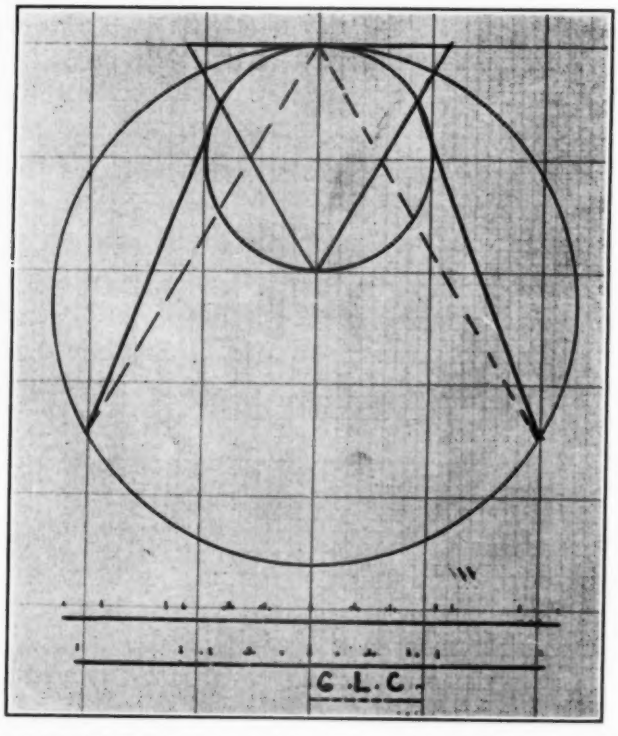

Fig. 1.—Showing the Bonwill-Hawley chart. Maxillary and mandibular arch wire lengths with scratch marks; the central, lateral and canine measurements for the radius of case in charge.

sion, and elongation tooth movements, possible by the first order of bends, giving the arch its ideal typal form; second, the mesial and distal tipping of teeth, resultant of the second order of bends, so important in combating the mesial drift of the buccal series so often met with in all classes of malocclusion; third, the root and crown shiftings resultant of the third order of bends, concerned with torque.

Although movements in the three planes of direction are possible simultaneously with this mechanism, we must realize that the first requirement for accomplishing this multiple tooth change is bracket engagement of all the teeth that are to be moved. Therefore the second and third order of tooth

movements must be secondary to any movements of the first order that are required to make feasible the seating of the arch wire in the slots of the brackets.

As to the technique of arch form determination presented by Dr. Angle, much has been written. However, due to subsequent biological research and practical application, several points of issue, conducive to modification because of their importance, are outstanding, and we may feel sure that should Dr. Angle be with us today, he would be among the first to recognize, introduce, and endorse them. First, in the technique given the profession on the subject of arch predetermination, because of the variance in results attained by each of us were we to form arch wires on the same case, we have sought for some plan which would serve as a guide in creating ideal arches for a given case, with less variation. This was derived from the use of the Bonwill

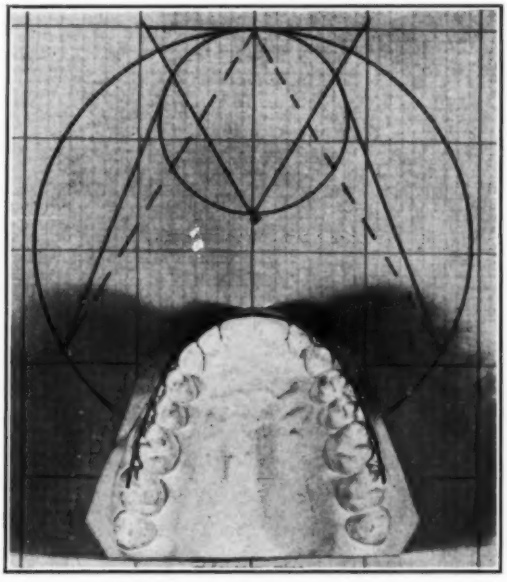

Fig. 2.—Showing an arch wire conformed to a Bonwill-Hawley chart created for a mesocephalic normal case with its tendency to approach closely the cutting edges of the teeth.

method as modified by the late Charles Hawley, and adapted by Chucks, Steiner, Furby, Strang, Waldron, Lasher, and others. The usual method of procedure in making the Bonwill-Hawley chart is given in detail in Dr. George C. Chucks' article, "Ideal Arch Form" (*Angle Orthodontist,* October, 1934, page 318). Fig. 1 shows the chart.

With this chart or pattern, we have an arch arranged and based upon an equilateral triangle, but proportional to the widths of the central, lateral, and canine of the case in hand. This outline figure is found to approach closely the cutting edges of the teeth of the case when normal. However, the ideal alignment arch which we create for our cases, and which the lines of this chart alone locate, is not placed upon the cutting edges of the teeth, so an enlargement must be made compensatory to the width of the bracket, the thickness of the band, and the necessary amount to carry the arch wire from the cutting edges of the teeth to the labial or the buccal surfaces at the

bracket level, approximating one-tenth of an inch. We therefore produce another arch drawing one-tenth inch larger and parallel to the original drawing. This enlarged arch wire drawing will then be used for the maxillary arch wire and is constructed first, using the original drawing for the formation of the mandibular arch wire.

The second point refers to the position the canine teeth should occupy in the arch, to do away with their pronounced propensity to a prognathic appearance, resultant of our adherence to the emphasis placed upon the straight line from the labial ridge of the canines to the buccal ridge of the mesiobuccal cusp of the first molar, expounded by Dr. Angle, who said, "this line is always straight, regardless of the degree or form of the curve of the anterior part of the dental arch." We are elsewhere informed that in most cases which have remained in good occlusion following the retention period, along with normal cases studied, there seems to be a definite step-out from the labial ridge of the canine to the buccal ridge and surface of the first premolar at the bracket level, being more pronounced in the mandibular arch than in the maxillary. Waldron,[2, 3] after making surveys of normal occlusions including models from the collections of Kelsey, J. Lowe Young, and Milo Hellman, found that to make an alignment arch straight back from the canine to molar, either pinched lingually the first premolar or moved labially the canines, resulting in the very toothy appearance before mentioned, with an abnormal shifting of their points of contact.

The third point deals with the relationship of the maxillary and mandibular arch wires in the molar region. In taking the arch wires carefully adapted to normal occlusion models at the bracket level and placing these arch wires in relationship to one another on a flat surface, it is found that they do not parallel each other, but tend to approach one another in the molar region, due to the fact that in these areas the brackets are almost in a vertical plane because of the inclination of the buccal surfaces of the molars.

With these three points in mind, it is with diffidence that I endeavor to amplify chronologically my conception of the technique and procedure to meet them, evolved from the efforts of the men previously mentioned.[4]

PROCEDURE

Establish the Bonwill-Hawley chart for the case in charge on graph paper ruled to tenths of inches; the mandibular arch wire is formed over this drawing while the maxillary arch wire is formed over the outline made one-tenth inch larger (Fig. 3).

Measuring the Maxillary Arch Wire.—With dividers take mesiodistal measurements of central and lateral incisors, allowing $\frac{1}{16}$ inch between distal-central and mesial-lateral markings, and punch the record on the card. These markings are to be made on each side of the median line. Take mesiodistal diameter of canines and reproduce on card separated from the distal-lateral point $\frac{1}{16}$ inch; the distance from the mesial surface of the first premolar to its buccal ridge is transferred directly to the record card without additional allowance. The distance from the buccal ridge of the first premolar to the buccal ridge of the mesiobuccal cusp of the first molar is transferred to the

record without additional allowance. The distance from the buccal ridge of the mesiobuccal cusp of the first molar to the mesial aspect of the second molar, or where this should be if present, is transferred to the record card.

After cutting arch wire material to the length of these markings, cutting one end diagonal for obvious reasons, with a sharp knife or the half-round pointed escapement file as procured by Frank A. Gough, scratch marks are now made on its broad surface at the following points: the median line, halfway point between central and lateral markings, halfway point between canine lateral markings, the distocanine mark, the buccal ridge of the first premolar, and the buccal ridge of the mesiobuccal cusp of the first molar.

Forming the Maxillary Arch Wire.—Subsequent to each modification, it is expedient that the arch wire be tested on a flat piece of glass to correct any

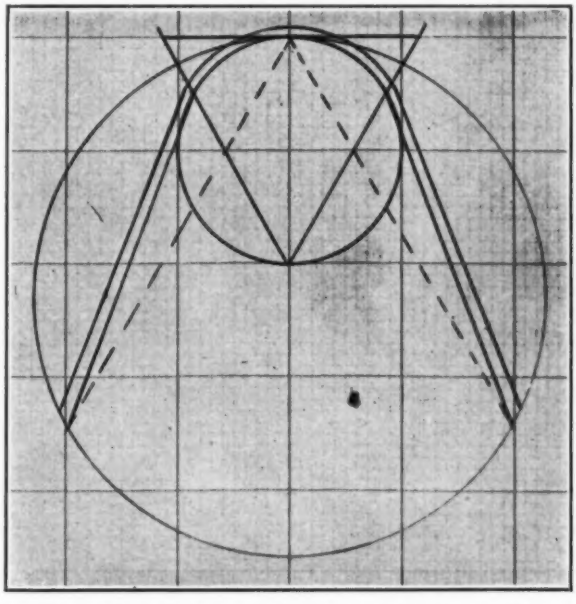

Fig. 3.—The Bonwill-Hawley diagram for forming the arch wires, with drawing for the maxillary wire 1/10 inch larger than the original.

deflection from the horizontal plane at any point. With the arch former as an aid, we conform the arch wire to the inner side of the Bonwill-Hawley diagram enlarged one-tenth inch over the actual size determined for the denture. The modifications for the lateral incisor areas are now made by grasping the arch wire with pliers No. 142 overlying the central lateral scratch mark. Being careful to hold the wire at right angles to the beaks, with the proper finger grip and fulcrum adjustment bend the mesial section of the arch wire lingually, bringing its end $\frac{3}{10}$ inch inside the maxillary arch wire drawing, when the unmodified side is placed in harmony with the chart. Place a mark on the diagram to indicate the location of the modified end, and also at the point indicative for a similar modification on the other side. Again place pliers on central lateral scratch marks and bend the distal section of the arch wire buccally an equal degree to the previous bend made mesial to the pliers. This amount will be indicated by placing the arch wire

on the graph paper and adjusting the uncorrected end to harmonize with the dot on the graph paper and bending the opposite end so that it lies parallel to the lines of the drawing separated from the diagram just the width of the lateral instep bend. Duplicate this modification on the opposite side. Now transfer the pliers to the lateral canine scratch mark, and bend the mesial section of the wire labially until the end on the side being modified lies 3/10 inch buccally to the maxillary arch wire diagram. This location is marked, as is a duplicate position for the opposite side, which is then similarly modified. Replace the pliers over the canine lateral scratch mark and bend the distal section of the arch wire lingually one-half the amount needed to bring it back to the diagram. Transfer the pliers distally the width of the beaks, and again bend the distal end of the arch wire lingually until it overlies the

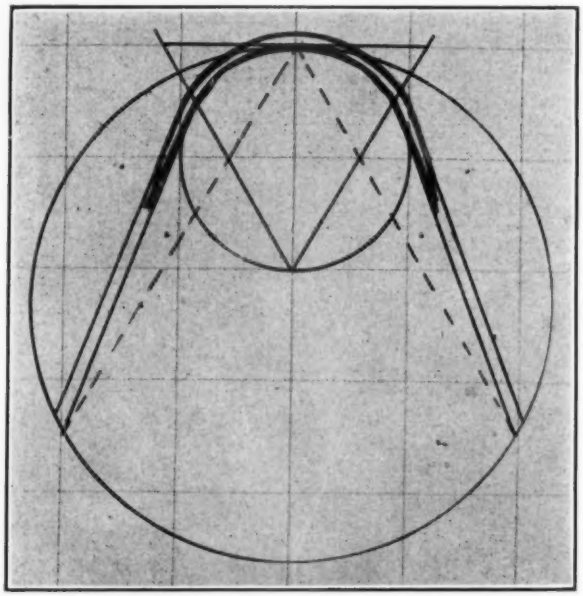

Fig. 4.—Showing the maxillary and mandibular arch wires formed and their relationship to diagram in Fig. 3.

corresponding section of the maxillary arch diagram. Similar modification is made on the opposite side of the arch wire. Now transfer pliers so that the distal edge of beaks is in harmony with the scratch mark indicating the location of the buccal ridge of the mesiobuccal cusp of the first molar. Bend the mesial section of the arch wire lingually, an amount to bring the end of the arch wire in contact with the inner or original chart drawing when the arch wire is placed in harmony with the enlarged Bonwill-Hawley diagram. Make the same modification on the opposite side.

Measuring the Mandibular Arch Wire.—Indicate on the record card on both sides of median line the mesiodistal width of the central and lateral incisors in apposition to each other. Take the mesiodistal width of the canine teeth, separate from distolateral 1/16 inch, and register both points of dividers on record sheet. Ascertain the measurement of the mesial edge of the first premolar to its buccal ridge, and separate it from the distal canine mark 1/16

inch, but record the buccal ridge point only. In direct apposition to the buccal ridge of the first premolar, record the distance from this point to the mesial aspect of the second molar, or where this would be if present, and record the same on chart. The arch wire material is now cut to proper length, and scratch marks are made by means previously mentioned on its broad surface, at the midcentral point; the midpoint between distolateral and mesiocanine mark; the distal-canine point; and the buccal ridge point of the first premolar.

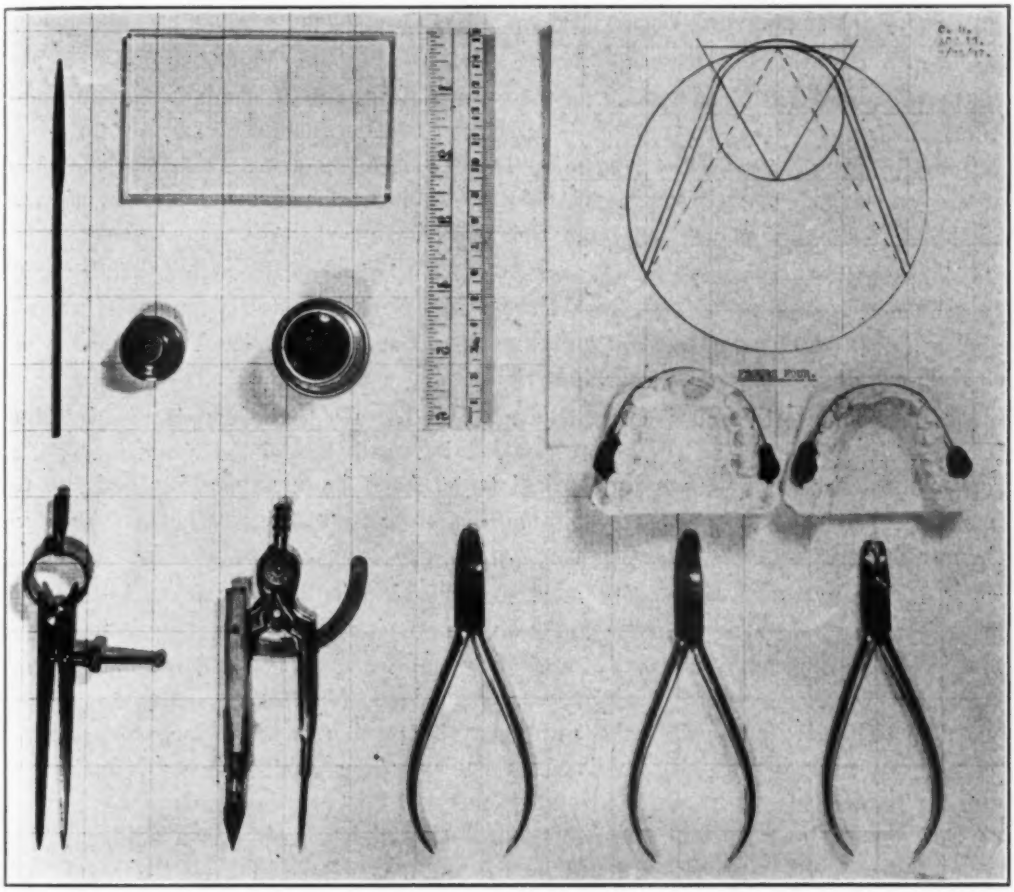

Fig. 5.—Completed arch wires adapted to case used in this paper, and instruments used in technique work.

Formation of the Mandibular Arch Wire.—The mandibular arch wire length is now conformed to parallel the inner edge of the original Bonwill-Hawley drawing. This, we should remember, is the inner one on the chart. With pliers No. 142, grasp the arch wire on the mesial side of the lateral canine scratch mark, and give the distal section of the wire a buccal bend to cause the end to locate $\frac{4}{10}$ inch from the outline drawing. Dot this location on the graph paper. Dot the opposite side in duplicate location, and modify the other side to harmonize with it. We now place the mesial side of the beaks at the canine lateral scratch mark, and make gradual bends with the fingers, curving the canine area of the arch wire by bending the distal end of

the wire lingually, sliding the pliers toward the distal canine mark after each bend, making at least six bends in this area until the end of the wire reaches a point $\frac{1}{10}$ inch lingual to the drawing. Mark with a dot this location and a corresponding one on the other side, to which the opposite of the arch wire is conformed. The pliers are now placed distally to the distal canine mark, and the mesial section of the arch wire is bent labially until its end is in line with the previously made dot $\frac{1}{10}$ inch buccally to the inner drawing. Duplicate the other side. Gradually curve the arch wire distal to the distal-canine mark, and in this area up to the buccal ridge mark of the first premolar by slight lingual bends, bringing the end of the arch wire halfway between the inner and the outer outline drawings. Duplicate these modifications on the opposite side of the arch wire. No lingual molar bends are made in the mandibular arch wire unless anchor bands are on the second permanent molar. When this is necessary, the lingual deflection is not made at the buccal ridge of the mesiobuccal cusp as previously done, but at the buccal ridge of the distobuccal cusp of the first permanent molar.

The value to the student of orthodontia and the satisfaction to the experienced practitioner resulting from time and effort invested in mastering this technique are well amplified in a paper read before the New York Society of Orthodontists on March 24, 1936, by Strang:[5]

"I became enthusiastic over this method from a teaching standpoint, but tested it thoroughly in clinical application before giving it to students. I can report most favorably upon its clinical tests, for I have never obtained results in denture form that appeared as harmonious to the patient's features as have those effected through adhering to a pattern form based upon this technique.

"It is now quite evident to me that variation in denture form because of type is never of great degree; and if we can produce dentures of such harmonious outlines as those that result from the use of ideal arch wire forms made according to the technique now practiced, Nature can readily do the typal readjusting for us as she balances the environmental forces that play over these biomechanically evolved dentures. The comforting advantage of always being able to turn to a definite pattern for comparison and reshaping of the powerplant that is our active and energizing guide is a factor of inestimable value. I can recommend its use with earnest and honest conviction."

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309 JACKSON STREET

FIVE YEARS WITH CHROME ALLOY

LEONARD T. WALSH, D.D.S., PUEBLO, COLO.

THE contents of this paper and the statements contained herein relate to the experience of three members of the Rocky Mountain Society of Orthodontists (Archie B. Brusse, J. Lyndon Carman, and Leonard T. Walsh), in the pioneering and development of chrome alloy for the construction of orthodontic appliances.

So much has been written and so much has been said for and against the use of this material that a brief history from the early days of discouragement to the present time of a highly refined and perfected technique, should be an inspiration to those interested.

In 1932 we decided to search for a metal, or group of metals, which would more nearly meet the requirements of our present-day concept of normal physiologic bone development and tooth movement; something that would eliminate, or at least minimize, breakage, reduce fatigue, and tarnish, and possess a low galvanic action. With this in mind the so-called stainless steel series was selected.

Let it be understood that we were not looking for a substitute, nor were we asking for economy; on the contrary, only those who passed through the developmental stage will ever know the sacrifice of time and expense that was necessary to overcome the many obstacles.

A number of different forms of stainless steel were tried and none would answer the purpose. Not until a material known as U. S. S. 18-8 chrome alloy was discovered, i.e., discovered as far as we were concerned, did we really make a substantial start.

The formula of this steel wire is an alloy essentially as follows: chromium 18 per cent, nickel 8 per cent, less than 0.15 of 1 per cent carbon, and the balance is of base metals used in making stainless steel. For orthodontic purposes it is necessary that this combination be stabilized with either titanium or columbium; it is nonmagnetic and cannot be hardened by heat treatment.

Table I was supplied by the Metallurgical Department of the United States Steel Corporation.

From Table I it is apparent that we had a material which supplied ample physical properties, but how to use it was the next problem. To theorize with paper and pencil was one thing, but the execution of the work and its behavior in the mouth were something else.

At that time it was not an easy matter to obtain chrome alloy in workable size; i.e., wires and band material. For example, the metal for molar bands

Prepared for the American Board of Orthodontia.

came in large sheets, which had to be cut the proper width, then cut again to measurement taken from natural teeth, soldered, contoured and finished in the mouth. The various forms of attachments, such as lingual and buccal tubes, etc., were not obtainable at all, so we had to make them; and in order to do this, it was necessary to have the proper instruments and pliers. There was nothing on the market suitable for this purpose, so we also had to make the instruments.

TABLE I

SIZE	ULTIMATE STRENGTH LB. PER SQUARE INCH.	% ELONGATION	YIELD POINT LB. PER SQUARE INCH
0.008	326000	1 max.	270000
0.010	310000	1 max.	240000
0.015	308000	1-1.5	235000
0.018	309000	1 max.	240000
0.020	290000	1 max.	225000
0.022	290000	1 max.	225000
0.028	287000	1 max.	220000
0.030	285000	1 max.	220000
0.032	284000	1 max.	210000
0.036	274000	1 max.	210000

We were then confronted with the problem of devising some method of uniting the various component parts of an appliance, and to this end the soldering process was selected, that being a natural inheritance. The only available flux and solders were those in common use for the so-called precious metals and these failed completely.

First a flux composed of hydrochloric acid, boric acid, borax and silica, and a 10K solder containing a high copper content were used. This combination proved only partially successful, and the formula of each was changed many times. With each change we felt we were approaching the ultimate goal, but the reward of the final test in each instance was dissatisfaction.

In soldering chrome alloy, great care must be exercised in every step of the procedure, especially the control of heat, for when this metal loses its physical properties, they cannot be restored by heat treatment. Just before we abandoned the soldering idea, we had a combination of flux and solder that appeared to work very nicely. The formula for this flux is the following:

Hydrochloric acid	2 mimims
Potassium fluoride (Baker's)	300 grains
Boric acid	200 grains
Borax	50 grains
Silica (150 mesh)	50 grains
Sodium carbonate	50 grains

and the solder a 500 fine gold solder containing less than 1 per cent copper and fusing at a point low enough to meet the requirements of chrome technique. This finished up beautifully and would stand almost any amount of abuse in laboratory tests, but when placed in the mouth it did not give the degree of satisfaction which we demanded. In my office these experiments were carried on not in one case, but in thirty to thirty-five cases simultaneously.

It does not require much visualizing to appreciate that one's professional reputation was in constant jeopardy.

It was at first thought that the soldered joints broke down from some action of the saliva, but scientific tests proved this not to be true. The fact of the matter was we did not have a union; there was no superficial alloying of the solder and the chrome alloy. It was at this stage that we received so much condemnation and so much destructive criticism.

While chrome alloy can now be successfully soldered, it is not practical for our work, neither is it necessary, nor is there anything to be gained by so doing, especially where time is a factor and simplicity is desired.

Here I should like to express my appreciation to such companies as the United States Steel Corporation and the Colorado Fuel and Iron Corporation, who gave willingly the resources of their research departments when consulted.

All of the above took place in a period of somewhat over a year, and about the end of 1933 any further attempt at soldering was abandoned entirely. Everything that had been done up to this time was discarded, and we started all over again.

At this point electric spot welding was taken up and met with a high degree of success from the start. This was in November, 1933, and progress has continued without interruption to the present time.

Spot welding is not new; it was known to the commercial world over seventy-five years ago.

Lucien de Coster, Professor of Orthodontia in Brussels, Belgium, was probably the first to use the principle of spot welding in orthodontia. Later Sheldon Friel of Dublin, Ireland, improved on his machine and technique.

To execute properly a neat, secure spot weld, so necessary in making orthodontic appliances, four essentials are involved: the current, electrodes, pressure, and timing. It is obvious what is meant by current; the voltage and amperage must be in proper relationship as it passes through the machine. The electrodes are the copper points between which the wires and attachments of an appliance are placed. There should be a variety of electrodes, quickly available and permitting of almost instantaneous change. While the spot welder comes equipped with a generous supply of electrodes, it is a simple matter to make any style to meet the requirements of the individual operator.

By pressure is meant the amount of force exerted between the electrodes when the wires are in place. This can be regulated to any degree, but for all ordinary purposes between 15 and 20 pounds is about right.

Timing is that portion of the operation which has to do with the electrical exposure necessary to unite or actually fuse, as it does, two particles of chrome alloy. Correct timing comes with practice; however, generally speaking, the time required is a fraction of a second.

I use the turret head spot welder, which incorporates all the above requirements and many other possibilities. There is one in each of my operating rooms, for convenience and time saving. They require no attention other than keeping electrodes free from foreign matter, and this is accomplished by simply drawing a piece of 000 emery cloth between the points; the cost of operating is negligible.

It makes little difference what style of appliances are used; select the one of your choice, that which you use in every day practice. The possibilities of stabilized 18-8 chrome alloy are limited only by the ingenuity of the individual operator; however, for purposes of description, the lingual arch with its various attachments and the labial arch with banded teeth will be outlined here.

Fig. 1.

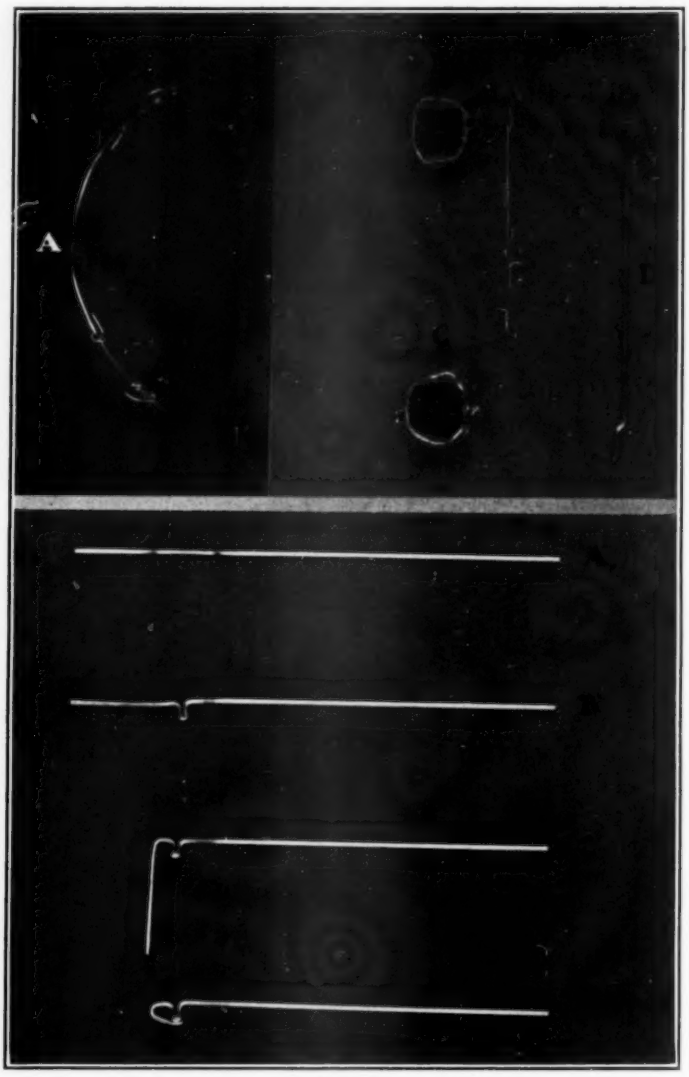

Fig. 2.

Beginning with the teeth commonly used for anchorage, there are twenty-four contoured seamless molar bands: twelve maxillary and twelve mandibular, made over dies which are accurate anatomical reproductions of natural teeth. This number will meet the needs of any occasion, including the deciduous dentition. Because of the fact that chrome alloy possesses a high degree of ductility, bands may be stretched two or three sizes and still have sufficient strength for all general purposes. This in itself is a great advantage should certain numbers be exhausted from reserve stock.

In fitting a maxillary molar band, select one that appears to be a trifle small, and with a wooden tongue blade, using considerable pressure, firmly force the band up approximately four-fifths of the desired distance and complete the seating with band adapters. At this point outline the gingival margin with a sharp instrument, remove, and trim. Return band to the tooth, this time using band pushers to complete the adaptation and, with the same instrument, put in lingual groove; the buccal groove is already present. The final seating is accomplished with the Eby band driver used on the lingual surface only.

This will draw the approximal surfaces in perfect contact at the cervix. The band is now ready for welding of the desired attachments, and when this is completed the band is sent to the laboratory for polishing. Up to this stage the working time is from six to ten minutes. It is almost impossible to remove with the fingers a band made in this fashion, and for that reason do not permit

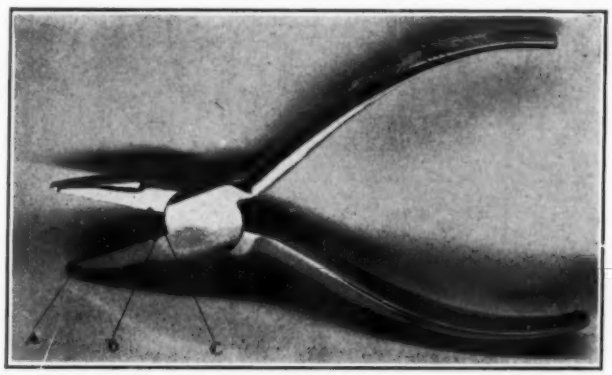

Fig. 3.

the material to extend too far under the soft tissue or difficulty will be experienced in removing the band after it has been cemented to place.

The technique for the mandibular bands is essentially the same as that described above. These bands are made on a twelve degree bias with the lingual groove; all other grooves and occlusal adaptation are done with burnishers or any other suitable instrument. Because of the twelve degree bias feature, start the band slightly toward the lingual, then with a tongue blade proceed with a rocking motion. Just before the band is ready for final seating with the band driver a piece of 0.030 wire about a quarter of an inch long is welded to the buccal surface a little below the center. For want of a better term I have named this a "convenience ledge," and its purpose is to afford a safe method of using the band driver, especially on the mandibular left. Fig. 1*B* illustrates this. The ledge minimizes percussion, and there is no danger of the driver slipping off or contacting the tooth in any manner. Where buccal attachments are used, the convenience ledge is not necessary. Fig. 1*C* illustrates a hook for intermaxillary elastics. Fig. 1*D* is a piece of 0.030 wire showing proper bending before welding to the band for hook. Fig. 1*A* illustrates labial arch with wrapped attachments referred to later. Molar bands,

like all other chrome alloy appliances, are polished but once, and they retain their luster as long as they are used.

Molar bands also will retain their shape and give satisfactory service during the entire period of the treatment, regardless of time.

Presuming that a lingual arch is to be constructed, a modeling compound impression is taken and poured in artificial stone or ordinary laboratory plaster. Laboratory plaster does very well for working models in the general run of cases, because there is little disintegration of the material from heat when the electric arch adapters are used.

The lingual arch and lingual tubes used in chrome alloy technique are those designed by Dr. Walter H. Ellis of Buffalo, New York.

Fig. 2 shows the four steps in making the loop and lock. A piece of 0.036 wire is annealed to a point a little more than a dull red; Fig. 2*A*, the loop

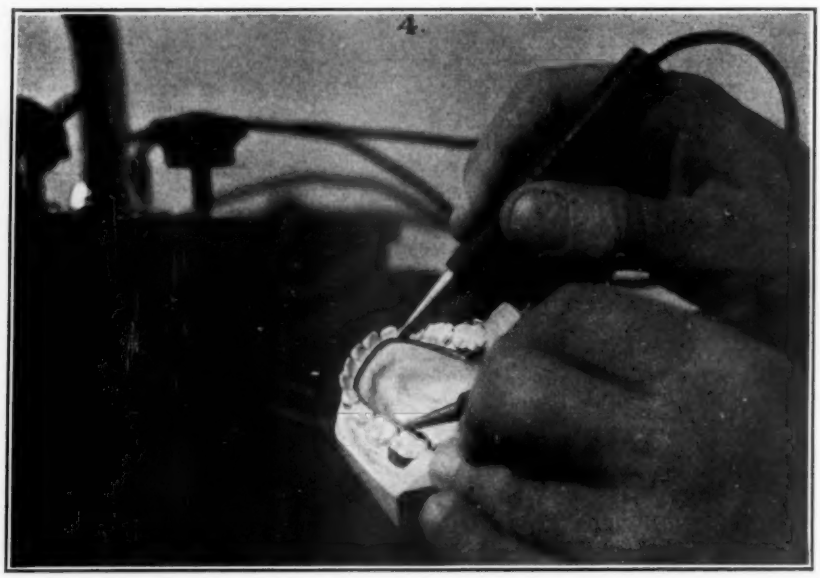

Fig. 4.

is made in the usual manner; Fig. 2*B*, using pliers as shown in Fig. 3; pliers of this size and strength are required, those of a lighter construction are not powerful enough for this tough alloy. Note groove *A* for making first bend, groove *B* for right angle bend and hole *C* (difficult to photograph) in which loop is inserted closing pliers firmly on wire, thereby assuring uniform dimensions for all loops. The one inch extension distal of the loop is for making the lock. This portion of the arch is annealed. Then with a medium grit seven-eighth inch diameter carborundum wheel mounted in hand piece, reduce the size of the wire one third. Holding the arch with round nose pliers close to the loop, make a right angle bend, Fig. 2*C*, now grasp the wire at the bend and complete lock as shown in *D*. It will be seen that the arch is made of one continuous piece of wire.

Place the arch on the model and adapt with electric adapters as shown in Fig. 4, which also demonstrates the correct position of the hands. When

placed in the mouth the arch will be absolutely passive, thereby reducing, if not entirely eliminating, the well-known uncomfortable reaction to the patient. Seven to ten minutes is ample working time from start to finish. It might be stated here that heavy duty wire cutters (Fig. 5) must be used for all wires. Do not attempt to cut any of these wires with the instruments in common use. They will make little impression on the alloy and your pliers will eventually be ruined.

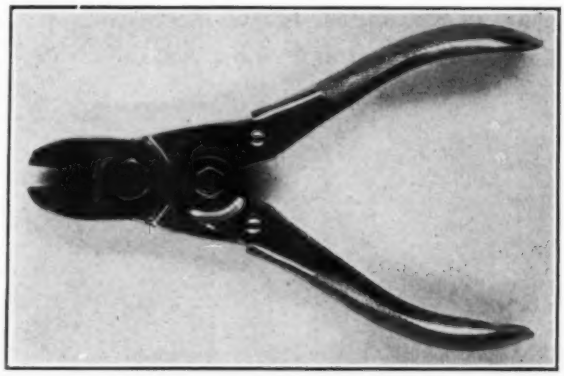

Fig. 5.

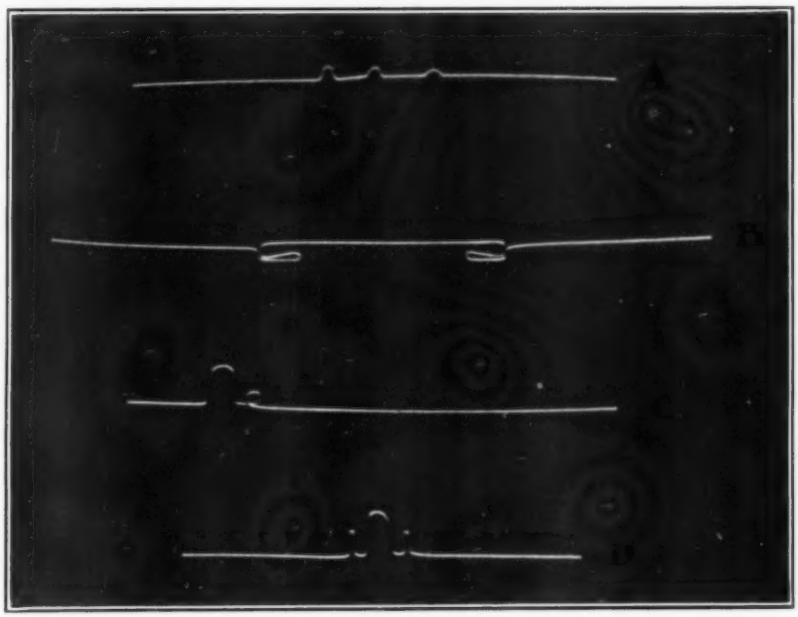

Fig. 6.

The labial arch is also fascinating and a pleasure to make. Where teeth are banded, wires of 0.015, 0.016 and 0.018 are generally used, although I understand that some men are using a twin arch as fine as 0.010. Under no circumstances is annealing of these wires permitted in the making of labial arches. All wires come polished and ready for use according to the requirements of the case. One end of the wire is placed in the buccal tube and from there on is threaded or seated in the attachment of your choice. Where stops

and small loops are needed, they are made in three different sizes as shown in Fig. 6*A*, by the use of special pliers (Fig. 7); intermaxillary hooks are made in just a few minutes by bending the wire on itself as indicated in Fig. 6*B*. For anterior or posterior movement of teeth, Fig. 6*C* works very nicely and Fig. 6*D* can be used for opening or closing spaces, root tipping, etc. Always avoid sharp bends in any of the chrome alloy wires, whether it be for arch manipulation or for auxillary springs.

I use S. S. W. pliers No. 342 shown in Fig. 8, for all bending operations of small wires and it serves the purpose very satisfactorily.

Fig. 7.

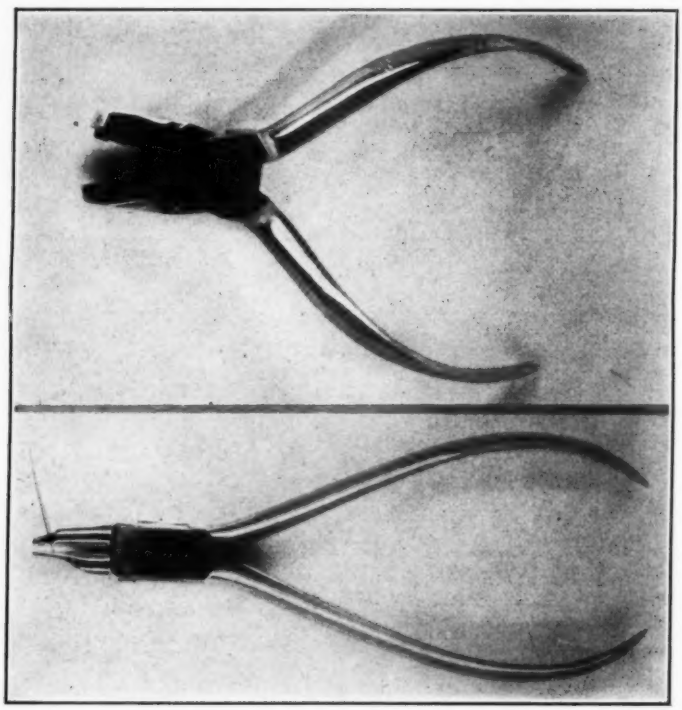

Fig. 8.

Where plain labial arches are indicated, the heavier wires, 0.030 and 0.036, are used, and the technique is somewhat different. Place the wire in the buccal tubes on a model and with electric arch adapters, conform wire to the desired shape. Then mark on the arch where the posterior loops and the intermaxillary hooks are to be placed. There are two methods of attaching hooks to large wires. One by direct spot welding as shown in Fig. 9*A*, using an 0.028 wire and the wrapping method, 0.018 wire as seen in Fig. 9*B*. Personally I have discarded the direct method entirely and in all cases use nothing but the smaller wires wrapped. To attach 0.015, 0.016 or 0.018 wire to the heavier one, the smaller wire is annealed with the electric annealing points of the turret head spot welder to a degree a little above a bright red. In annealing any of the wires it makes no difference whether they are air cooled or quenched in cold water. I chill wires immediately to save time.

There is no such thing as heat treatment with chrome alloy; once softened, the original properties cannot be restored.

Cold working increases the temper five to eight times.

Now we are ready to assemble the wires. Place the annealed portion of the smaller wire across the arch at right angle, Fig. 10*A* and at a point where two wraps around the larger wire will bring the smaller wire into its spring zone; i.e., to an area that has not been annealed, Fig. 10*B*, obviously this is

Fig. 9.

Fig. 10.

important. Bend the short end of the wire over the wrapped portion as shown also in Fig. 10*B;* weld to main wire and cut off excess. The finished product can be seen in Fig. 10*C*. Wires attached in this manner cannot come off and will always be found in the mouth when the patient returns. I often wonder how many auxiliary springs have not been accounted for.

Instead of scratching a wire with a file, I mark the point of attachment on the arch, either in or out of the mouth, with a lead pencil. A soft lead, about a number one, serves well and when sharpened in a wedge shape, will accurately indicate the exact point to place the wire.

Anterior bands are made by the pinch method, and the chrome alloy band material is obtainable in any desired width and thickness. The attachments are numerous. However, for the most part those used in my office are shown in Fig. 11, and each individual attachment is sectioned or cut about halfway through the metal so that when one side is welded to the band it can easily be separated from the strip by bending. All attachments are flanged, extending latterly from the operating portion of the attachment. This is the medium by which the unit is welded to the band. Place the band between the electrodes with the attachment in the proper position, and with a quick sharp blow on the plunger of the spot welder, make one weld, then break off from the strip. If there is any question about the correct location of the attachment, try in mouth. If position is satisfactory, return to welder and make

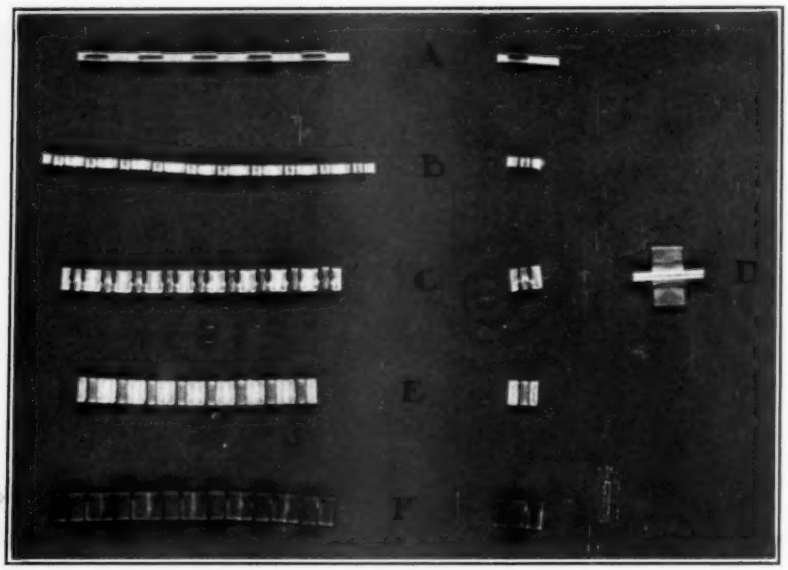

Fig. 11.

from three to six welds on each flange, depending on the size. A nice little piece of efficiency is demonstrated here; suppose we are going to put a long buccal tube on a molar band. Place between the electrodes in the usual manner and make one spot only in the middle of the flange toward the gingival, return to the tooth and should the tube be too far up or too far down, simply turn to the proper alignment as the one weld will act as a pivot which will permit moving and still hold the tube securely in place. In case the tube is too far forward or backward, twist it off and start over again, being more careful this time.

When the attachment is securely welded to place, grind out the slight pits caused by welding, with a stone and finish the margins of the flange to a feather edge; remove scratches with fine emery disks and polish on lathe using chromium polishing compound on a chamois wheel. This polishing material is a chromium carbonate in a stearin base.

Fig. 11*A* shows McCoy's open tube attachment in strips and a single piece; Fig. 11*B* snap channel bracket attachment; Fig. 11*C* Ketcham snap hook; Fig. 11*D*, long buccal tube; Fig. 11*E* short buccal tube and Fig. 11*F* lingual tube for Ellis arch. Photographs of all material shown here are of actual size.

When welding the long buccal tube on molar bands, the buccal groove is often destroyed; this can be restored accurately by using plier shown in Fig. 12.

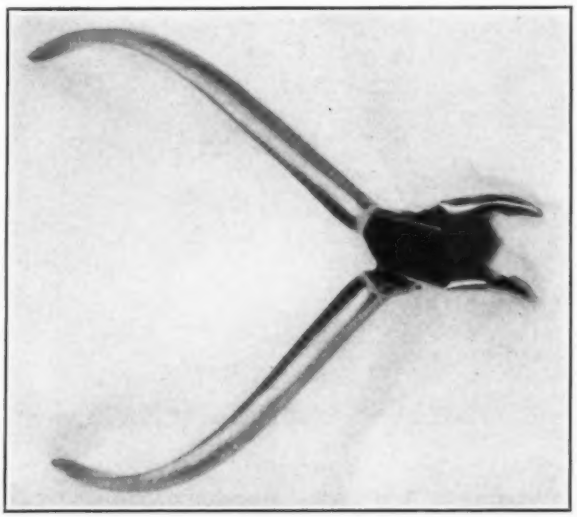

Fig. 12.

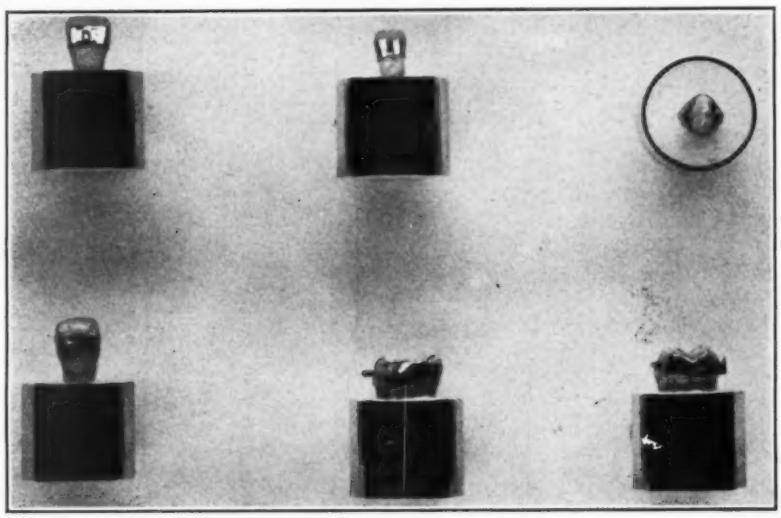

Fig. 13.

Fig. 13 shows how the above attachments look when finished and mounted on natural teeth.

Fig. 14 shows appliances used in a practical case, demonstrating the short buccal tube, stop loop just anterior to it, intermaxillary hook, and an 0.016 wire inserted in Ketcham snap hooks. The lower is a lingual arch and the molar band shows a hook welded to it.

All appliances are made in the operating room. In Figs. 15 and 16 is seen an efficient installation and convenient relationship of cabinet and chair.

Fig. 17 shows containers for keeping the reserve stock of wires in good condition. Each tube is numbered, indicating the size of wire it contains and mounted with adhesive tape.

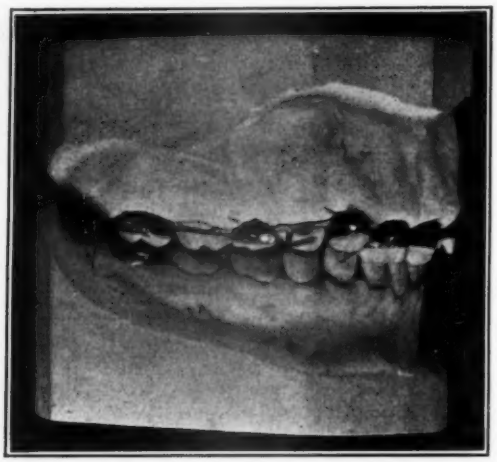

Fig. 14.

Fig. 15.

Fig. 18 is a close-up of the turret head spot welder, showing the working units of the machine: *A* is the heat control rheostat, which can be turned instantly to low, medium or high; *B* indicates the electrodes; *C* is a plunger or contact switch, which when struck a quick sharp blow with the closed hand allows the electric current to pass through the chrome alloy parts to be united, actually fusing them together; *D* indicates the electric annealing points which

can be removed for plugging in the electric arch adapters when their use is required. The wire annealed in the picture is overheated for photographic purposes.

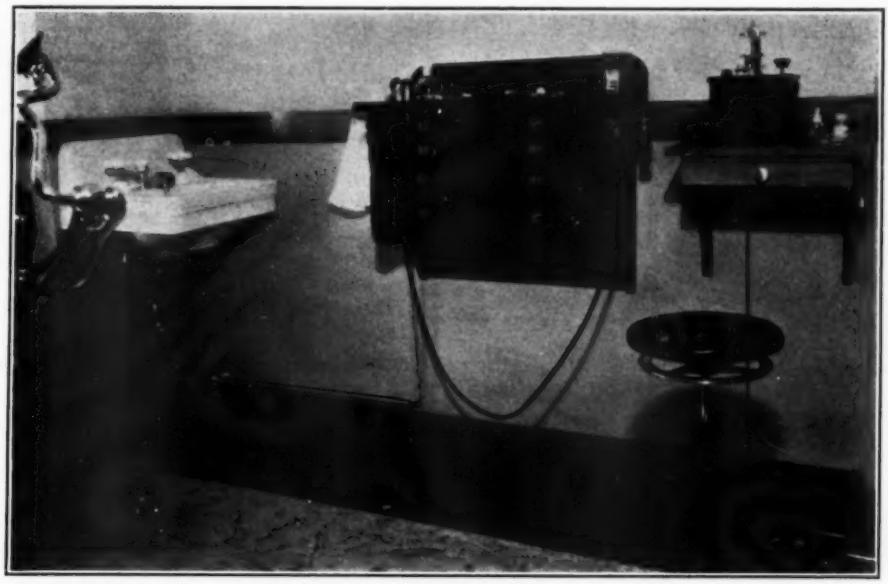

Fig. 16.

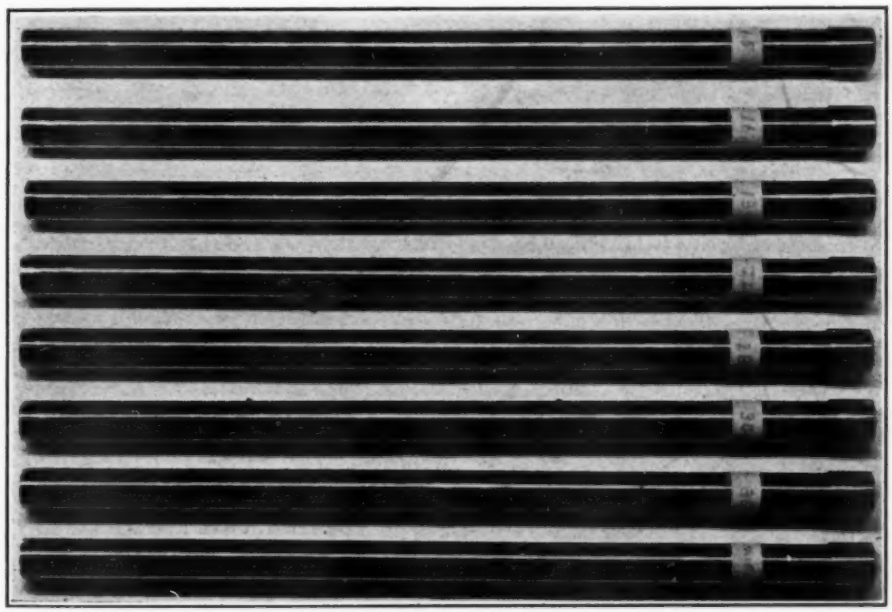

Fig. 17.

Some of the many advantages that recommend the use of chrome alloy may be summed up as follows:

1. No acids, flux or soldering paraphernalia of any kind is necessary.

2. No flame to blow out; spot welding may be done in the direct breeze of an electric fan or in front of an open window. I had the gas removed from my office two years ago.

3. Breakage is reduced almost to nothing, and, when it does occur, it is my belief that it is due to faulty technique or to deliberate effort on the part of the patient.

4. Extremely low cost.

5. No waiting for appliances to cool off. No heat treatment.

6. Less interference with normal function.

7. More sanitary. Polish once only.

8. Tubes, attachments, etc., will not wear or stretch. Arches always fit.

9. Four times lighter and stronger than the next strongest material.

10. Cold working restores temper five to eight times.

11. Thinner and smaller materials are used.

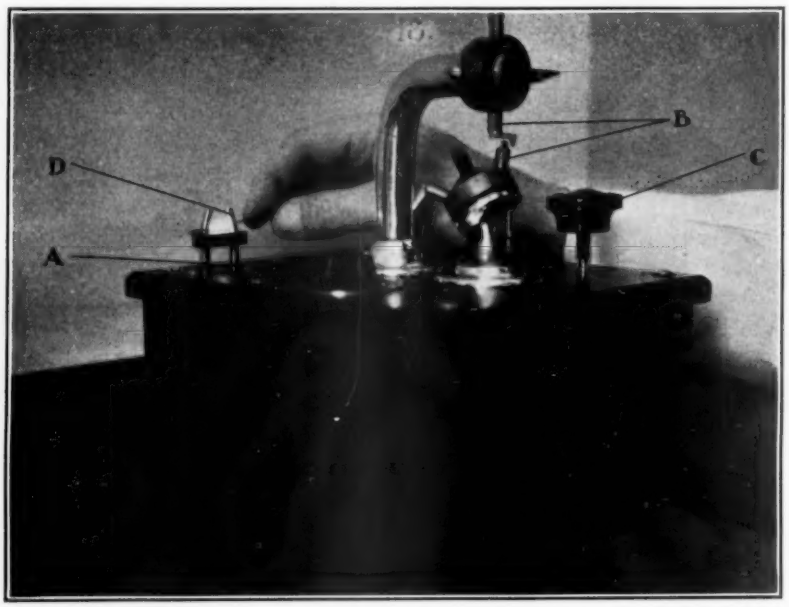

Fig. 18.

12. No disintegration of working models from heat.

13. Tissue toleration is ideal.

14. Patients are seen less frequently and appointments are of shorter duration; therefore it is apparent that more cases may be carried and experience has proved this to be true.

A well-known railroad has this to say regarding its new super-zephyrs, built of stainless steel: "By far the strongest and most permanent of all modern alloys."

To carry any new adventure to a successful conclusion requires an abundance of patience and perseverance, but the reward has justified the effort.

I have no interest in chrome alloy other than the scientific advancement of the mechanics of orthodontia.

PROFILE RADIOGRAPHY

An Aid in Correlating Soft and Hard Structures of the Face and Transposing Frankfort Horizontal Plane to Radiograph

Michael J. Maxian, D.D.S., New York, N. Y.

THERE are, at present, a few existing methods of correlating the soft and hard structures of the face by using a profile radiograph. To this group I wish to add still another merely as a suggestion and not as a perfectly completed entity. I believe that it offers a good start for some one with

Fig. 1.—Showing placement of the radiopaque string. Also shows metal mouches at orbitalia and tragion.

greater imaginative resources and a better knowledge of chemicals and minerals as the need may be. The method is very simple, requires very little time and offers no discomfort to the patient. This correlation is very important to the orthodontist and can be used to great advantage by the prosthodontist and other specialists in restoring or recording facial relationships.

The patient is prepared in the usual manner for a profile radiograph. The only additional material required is a piece of darning cotton made radiopaque by incorporating a metallic paste into and around it. This paste is prepared by mixing 1 part of barium sulfate and 3 parts of any silver alloy (amalgam alloy) with enough glycerin to form a fairly heavy paste (thick enough so that it will not run or flow too easily). The alloy should be triturated in a

mortar before mixing in order to pulverize the particles as finely as possible. The paste may require a little thinning from time to time by adding more glycerin and should be thoroughly stirred before using. A piece of darning cotton (Clark's 4 ends of 2 ply) cut to the required length is immersed into the paste and agitated so that it becomes thoroughly impregnated with the paste. Thus, the string becomes radiopaque and ready for use. The patient

Fig. 2.—Radiograph with line marking the profile outline of the soft tissues; another line marks the Frankfort horizontal plane (this is somewhat curved because of the slight tilting of the head). The profile line has been accentuated for photographic purposes.

must be fully prepared and his head positioned as desired before placing the string on the face (that is, just before making the exposure). The string is handled with two pairs of cotton pliers to avoid touching it with the fingers and removing some of the paste. Grasp one end of the string with one plier and at about the center with the other plier. Begin placing it at the hair line and cautiously follow downward to the superior border of the thyroid cartilage or thereabouts (Fig. 1). In very young and nervous patients, it is

advisable to snip the string at the mouth line to permit them to speak, as they invariably will do, without dislodging the string. If the interest lies in obtaining only the profile relationship of the patient, the next step is to place the cassette and expose the film. If, however, one also wishes to obtain the Frankfort horizontal plane on the radiograph, proceed as follows: mark the orbitalia and tragion on the left side and with a flexible ruler connecting

Fig. 3.—This shows the ordinary profile radiograph which lacks any correlation between hard and soft tissues.

these two points draw a light line on the face with a dermatograph or soft pencil. Then place another piece of the radiopaque string on the line exactly from orbitalia to tragion. Metal mouches are not absolutely essential in marking the definite cephalometric points but are very helpful especially in the region of the tragion whenever the densities of the surrounding bone and of the metallic string are very much the same. Next, place the cassette and expose the film. The resulting radiograph (Fig. 2) will show a fine line mark-

ing the profile of the soft tissues; another line from orbitalia to tragion would designate the Frankfort horizontal plane, and detail in the hard structures. Use the customary exposures for these radiographs or slightly less, 5 to 6 seconds with tube at 36 inches from patient. Some definite and standard head fixation apparatus should be employed in order to insure identical readings from time to time.

After the final exposure, the string is removed from the face with the pliers. The remaining paste is wiped from the face with soft tissue and a face cream or petrolatum. This procedure offers very little difficulty.

I wish to express my gratitude to Dr. George S. Callaway and to Dr. L. M. Waugh for their helpful suggestions and criticism.

576 Fifth Avenue

GNATHOSTATIC DIAGNOSIS IN ORTHODONTIA

B. L. Herzberg, D.D.S., M.D.S., Chicago, Ill.

THE object of this clinic is to illustrate the method of making orthodontic diagnosis in three planes of space, wherein the dental structures, the alveolar bone, and the underlying basal bones are related to the cranial anatomy. Thus it is possible to determine, by means of this method of diagnosis, the relative

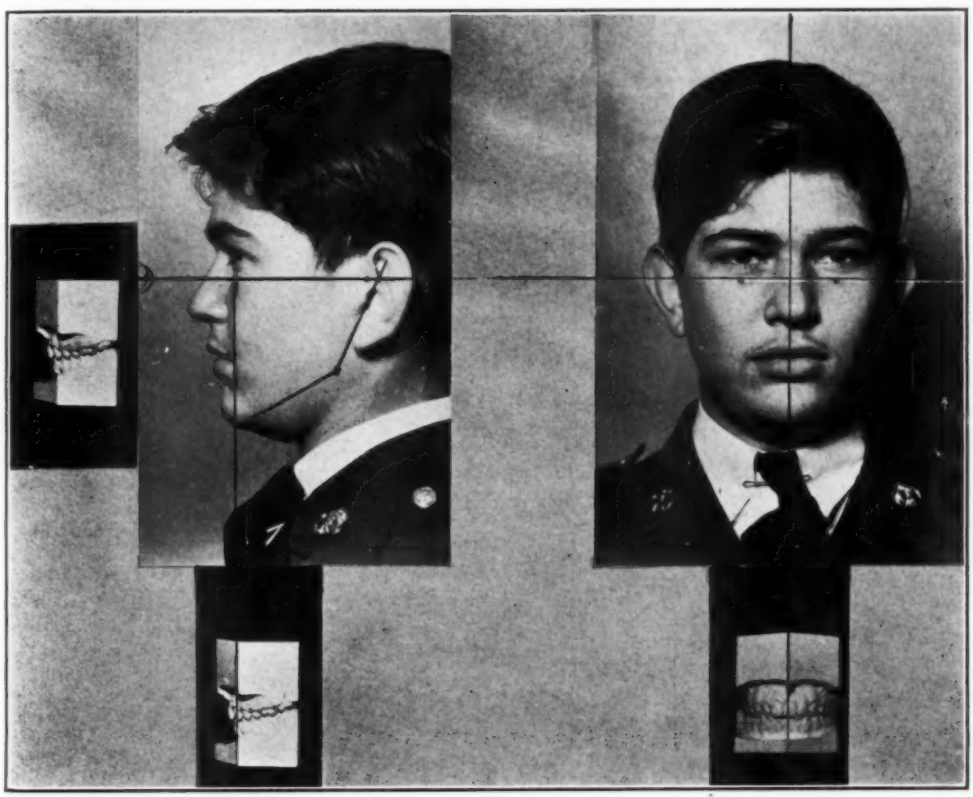

Fig. 1*A*. Fig. 1*B*.

forward and backward position of the teeth and jaw bones with reference to the cranium, as well as the degree of expansion or lack of expansion and the degree of vertical growth or lack of vertical growth of the teeth and underlying bones. This is done by means of a model that is oriented to the cranium, as well as by photographs which are also oriented and taken with a definite technique. The clinic also concerns itself with a technique involved in these procedures.

It is not claimed for this method that it is fool-proof nor that it is a solution to all our diagnostic dilemmas but that it is of tremendous aid to orthodontic

Presented at the Thirty-Fifth Annual Meeting of the American Society of Orthodontists, Chicago, Ill., April 17-22, 1937.

Fig. 2*A*. Fig. 2*B*.

Fig. 3*A*. Fig. 3*B*.

diagnosis when coupled with other methods at our command, sound judgment and experience.

All the photographs are taken by a standardized technique. A fixed focus camera is used. The distance from the object to be photographed is always the same; the lighting effect is uniform, as are the time and the aperture opening. Our photographs, therefore, are always one-quarter life size and may be measured with some degree of accuracy.

The perusal of Figs. 1*A* to 4*B* will help to illustrate the points I have attempted to make clear.

Fig. 1*A* illustrates the photostatic picture with the gnathostatic models (profile view) wherein the eye-ear (Frankfort horizontal) plane is the top of the model and wherein the orbital plane, dropping at right angles to the Frankfort horizontal plane and from orbitale, is represented by the labiobuccal corner

Fig. 4*A*. Fig. 4*B*.

of the model and which, in the majority of correct occlusions, passes through the maxillary cuspid teeth and in the vicinity of cheilion (the corner of the mouth).

Fig. 1*B*, a front view, shows the midpalatal plane as passing through the labial corner of the model. This represents a case in relatively good occlusion and harmonious relationship of the dentures to the cranium.

Fig. 2*A*, photographs and models oriented in the same manner as Fig. 1*A* and *B* showing a total mandibular retraction in which the mandibular bone, itself, is markedly underdeveloped and the mandibular dental structures are too far back, with relation to the cranium.

Fig. 2*B* shows a front view of the same patient.

Fig. 3*A*, photographs and models oriented in the same manner as Fig. 1*A* and *B*, shows a marked mandibular protraction in which the mandibular bone is markedly overdeveloped in a forward direction and in which the mandibular dental structures are too far forward with relation to the cranium.

Fig. 3*B*, a front view of the same patient.

Fig. 4*A* illustrates the maxillary impression tray in place, with a gnathostat adjusted to the tray handle, showing the position of the beam, with the pointers touching the left tragial and the left orbital points; Fig. 4*B* shows a front view of the same gnathostat, in position, with the pointers touching both orbital and both tragial points. This arrangement develops the Frankfort horizontal, or eye-ear plane along the horizontal beam and determines the position of the top of the model as the Frankfort horizontal and the plane at right angles to the Frankfort horizontal as the orbital plane, as illustrated by the plane in Fig. 4*B* drawn vertically to the orbital marker.

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Edited by

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Articles on oral surgery, radiography, and anesthesia should be submitted to Dr. Sterling V. Mead, 1149 Sixteenth Street Northwest, Washington, D. C. Articles on oral pathology should be submitted to Dr. Kurt H. Thoma, 47 Bay State Road, Boston, Mass.

BLOOD DYSCRASIAS FROM A DENTAL POINT OF VIEW

THOMAS J. COOK, D.D.S., PHILADELPHIA, PA.

PART I

ACCUMULATED evidence collected from clinical data of cases of blood dyscrasias has established the fact that in many instances symptoms appeared in the mouth as the first sign of the disease. Oral manifestations of blood dyscrasias form a very important group of mouth lesions, and while I do not contend that it is possible to make a diagnosis of any form of blood dyscrasia by merely an oral examination, still one must feel that since the earliest symptoms of such disease appear in the mouth, early recognition would lead to early diagnosis and hence a more favorable prognosis.

It is with this thought in mind, that as dentists, we find ourselves confronted with the problem of putting the mouth in a healthy condition and knowing something of the relation of general health to mouth health, as well as mouth health to general health, that this paper is written.

AGRANULOCYTOSIS

Primary granulocytopenia, agranulocytic angina, polymorphonuclear leukopenia, descriptive terms meaning a marked increase in or total of granular leukocytes in the peripheral blood.

Conner[1] and his associates applied the term agranulocytosis to the condition in which there is complete or almost complete absence of granular leukocytes, accompanied by leukopenia and relative increase, but, in most instances, absolute decrease of lymphocytes.

Appleton[2] deserves credit for being one of the first to attract the attention of the dental profession to this condition in a comprehensive report given before the New York State Dental Society in 1931. He chose as his subject "Agranulocytosis," because "of the widespread interest shown in it at the present time and because it will illustrate the essential unity of medicine, particularly the interrelations between oral conditions, on one hand, and extraoral or general conditions on the other."

From the University of Pennsylvania, School of Dentistry.

Schaeffer[3] (Chicago) in 1934 stated "A further reason that this disease, which represents a grave, acute medical emergency with a mortality of about 90 per cent, must interest dentists, is that, in a large number of reported cases, it has followed tooth extraction."

Cases Reported Following Tooth Extraction—

Christian and Hinton[4] (Atlanta) reported that a female, aged 52 years, six weeks before the onset of the disease had eleven teeth removed, and following the extraction the gums were extremely sore for several days. Painful necrotic ulcers developed in the mouth, and the patient died on the forty-fourth day of her illness. The diagnosis was agranulocytic angina.

Flexner[5] (Louisville) reported a case of agranulocytosis: May 2, 1931, a female, aged 38 years, presented herself complaining of facial neuralgia. One week previously, April 28, two teeth had been removed, hoping to relieve the neuralgia. There had been no pain at the site for two days, at which time it returned and persisted. The two sockets where the teeth had been removed were healing slowly; the gums were injected, showing a grayish exudate. The blood count revealed R.B.C. 4,070,000; W.B.C. 920; Hb. 78 per cent; polymorphonuclears 2 per cent; lymphocytes 98 per cent. The patient died on May 8.

Franken and Hensel[6] (New York): A male, aged 31 years, well-developed and well-nourished white man, was admitted to Lenox Hill Hospital, New York, February 11, 1926, with the following history. Two weeks previously the maxillary left premolar had been extracted. He was treated by his dentist for Vincent's infection, because of an ulceration at the retromolar triangle on the left side. All gold crowns and stationary bridges were removed to establish a better hygienic condition in the mouth. On February 10, the dentist referred the patient to a rhinologist for treatment of a swollen left tonsil. The physician incised but obtained no pus. The following day the patient became dizzy and malaise appeared; he was admitted to the hospital. On February 17 there was edema of the palate on the left side with ulceration. The patient died on March 2. The diagnosis was agranulocytic angina.

Leys[7] (England): A woman, aged 33 years, appeared at Selly Oak Hospital, March, 1932. Oral examination disclosed a severe stomatitis with pale, swollen and retracted gums, and with much dental caries present. The worst teeth were extracted early in April under nitrous oxide. Medical treatment was continued until she demanded her discharge. After returning home she became acutely ill, returned to the hospital within a week, and died the day following admission. The diagnosis was agranulocytosis.

Aison[8] (Chicago): July 14, 1933, S. H., female, aged 32 years, was admitted to the hospital. She had been in good health until two weeks previously, when an attempt was made, by a dentist, to extract several teeth. The extraction was a difficult one. The gum tissue was lacerated, and postoperative hemorrhage continued for three days. The patient had severe headaches, fainting spells, fever, and general weakness. Oral examination revealed a marked swelling of the left side of the face and submaxillary region, large grayish necrotic clots over the areas of recently extracted teeth, and slow oozing of blood from the

gums around the remaining teeth. Patient discharged August 13, 1933, apparently cured. Diagnosis: Agranulocytosis; necrosis, left mandible.

Foran, Sheaff and Trimmer[9] reported a case in which an oral slough developed following the extraction of a tooth. The patient was a female, aged 39 years. Blood studies revealed an agranulocytic angina. The patient recovered.

Walls[10] (Bethlehem, Pennsylvania): On May 26, 1934, a female, aged 46 years, was admitted to St. Luke's Hospital. The following history was obtained:

November 1, 1933:	Sore mouth developed, which cleared up but returned again later in the month.
December 1:	Confined to bed after a fainting spell.
December 6:	Blood count: W.B.C., 4,350; polymorphonuclears, 9 per cent; lymphocytes, 67 per cent; myelocytes, 11 per cent; and mononuclears, 13 per cent.
December 16:	A large slough developed on right cheek (orally) which responded to treatment.
January 5, 1934:	Another ulcer appeared on right cheek.
January 22:	Patient up and around the house again.
April:	Two mandibular third molars removed.
May 16:	Patient had a fainting spell; mouth became very sore.
May 28:	Admitted to St. Luke's Hospital, Service of Dr. Walls. *Oral examination:* Large nonmarginated ulcers on both cheeks (orally), on the tongue and in the floor of the mouth; also an ulcer of lower lip. *Blood count:* W.B.C. 2,350, polymorphonuclears 1 per cent, lymphocytes 96 per cent, monocytes 3 per cent.
June 4:	The condition of the oral cavity was at its worst, with the palatal tissues hanging as a slough. The periosteum was exposed, and eventually a sequestrum formed, and several teeth were removed, which were almost exfoliated.
September 10:	The patient responded well to treatment, the remaining teeth had tightened, and the patient was discharged feeling well. The diagnosis was granulocytopenia.

Babbitt and Fitz-Hugh[11] (Philadelphia): A female, aged 29 years, nurse, was admitted to the University Hospital June 21, 1929. The patient was in a moribund state, temperature 104° F., pulse 130. Leucocyte count was 600 with polymorphonuclears totally absent. This attack immediately followed the extraction of a maxillary left molar under gas anesthesia. The following day the patient became increasingly weak, and in two days ulcers made their appearance in the mouth, which developed into an extreme ulceration and necrosis, resulting in the loosening of some teeth and exfoliation of bone. Films of the mouth showed bone necrosis.

Several years previously the patient had had a severe attack of Vincent's angina.

Medical treatment was instituted, and the patient responded. The alveolar margins above and below were filled with necrotic sloughs which first increased under treatment, but later showed encouraging responses. The patient recovered and is now doing active nursing. The diagnosis was agranulocytic angina.

The following patients were seen at the University Hospital.

CASE 1.—Mrs. S., first admission, March 8, 1930. Female, aged 45 years, admitted to the University Hospital.

Onset of present illness began in December, 1928, which was followed by four similar attacks between December and the following June, and again similar attacks occurred between December, 1929, and March, 1930.

March 1, 1930: Patient had a severe attack, very sore mouth with cervical glandular enlargement.

March 5: Patient noticed a swelling of the palate that caused her to vomit. Gums were tender; she was unable to use a toothbrush.

March 8: Patient admitted to University Hospital. Oral examination revealed ulceration on lower lip, bleeding gums, angry in appearance, and a heavily coated tongue.

Blood count: R.B.C., 5,160,000; W.B.C., 2,400; Hb., 77 per cent.

Differential: Neutrophiles, 4 per cent; lymphocytes, 92 per cent; monocytes, 4 per cent.

March 10: The condition of the mouth was slightly improved. The patient spent a comfortable night.

Blood count: R.B.C., 4,200,000; W.B.C., 1,600; Hb., 85 per cent.

Differential: Neutrophiles, 4 per cent; lymphocytes, 91 per cent; monocytes, 5 per cent.

March 11 to March 29: During this time the clinical status of the patient greatly improved. Lesions in the mouth disappeared, and the patient was discharged to a convalescent home on March 29.

Blood count: R.B.C., 4,200,000; W.B.C., 5,100; Hb., 78 per cent.

Differential: Neutrophiles, 65 per cent; lymphocytes, 31 per cent; monocytes, 4 per cent.

Second Admission:

April 15, 1930: Patient returned to hospital with a recurrent attack of agranulocytic angina. Severe gingivitis was present, and the patient's mouth had been extremely sore for the past week.

Blood count: R.B.C., 4,700,000; W.B.C., 400; Hb., 90 per cent.

Differential: Neutrophiles, 1 per cent; lymphocytes, 23 per cent; monocytes, 1 per cent (25 cells counted).

April 18 to May 10: Patient showed improvement in the general appearance of the mouth and in the blood count. She was discharged on May 10.

Third Admission:

August 17, 1930: Gingival infection began two days previously, which was accompanied by headache, dizziness, weakness, and insomnia.

Blood count: R.B.C., 5,100,000; W.B.C., 1,900; Hb., 80 per cent.

Differential: Neutrophiles, 30 per cent; lymphocytes, 66 per cent; monocytes, 4 per cent.

August 18 to August 25: The condition of the mouth gradually became worse. There were ulcerations about the gingiva both in the maxilla and the mandible.

August 26 to September 16: There was a gradual improvement in the condition of the mouth, the patient again having responded to the treatment prescribed by the physicians in charge.

Blood count: R.B.C., 5,400,000; W.B.C., 4,700; Hb., 100 per cent.

Differential: Neutrophiles, 64 per cent; lymphocytes, 32 per cent; monocytes, 4 per cent.

The patient was again discharged to a convalescent home.

Fourth Admission:

October 10, 1930: The blood count was R.B.C., 5,000,000; W.B.C., 1,200; Hb., 95 per cent. Differential: Neutrophiles, 0; lymphocytes, 78 per cent; monocytes, 2 per cent.

The general reaction of the body had again manifested itself in the mouth. The gingival tissues were inflamed and bled easily. Ulcerations were present on the palate in the incisor region.

October 11 to November 5: In spite of constant attention to the ulcerations, they seemed to get progressively worse until about November 5. This can be well explained in the blood count of that date: R.B.C., 4,600,000; W.B.C., 3,700; Hb., 90 per cent.

Differential: Neutrophiles, 66 per cent; lymphocytes 30 per cent; monocytes, 4 per cent.

The patient gradually improved under a variety of treatments, so well that a tonsillectomy was done on December 9. She was discharged on December 17. The W.B.C. has not been below 6,000 since tonsillectomy was performed.

Fifth Admission:

January 7, 1931: Readmission note: Patient looked and felt perfectly well. Examination of mouth showed no ulceration and no gingival infection. Tongue was clean. Throat was entirely negative.

Blood count: R.B.C., 4,300,000; W.B.C., 5,400; Hb., 81 per cent.

Differential: Neutrophiles, 70 per cent; lymphocytes, 25 per cent; monocytes, 5 per cent; platelets, 256,000.

January 8 and 9, 1931: Patient observed. Given preoperative medication.

January 10: Three pulpless teeth removed. Novocaine anesthesia.

January 11, 1931: Patient had no reaction following removal of pulpless teeth.

Blood count: R.B.C., 4,500,000; W.B.C., 6,350.

Differential: Neutrophiles, 72 per cent; lymphocytes, 23 per cent; monocytes, 3 per cent.

Urine: colorless; sediment clear; sp. gr. 1.012; reaction acid; albumin 0; sugar 0.

Sixth Admission:

October 5, 1931: Patient returned for check-up after being symptom free for the past six months.

This was the first check-up since tonsils and teeth had been removed.

Blood count: R.B.C., 4,800,000; W.B.C., 5,600; Hb., 88 per cent.

Differential: Neutrophiles, 67 per cent; lymphocytes, 27 per cent; monocytes, 4 per cent.

Blood count revealed patient to be almost normal hematologically.

October 6: Patient given a thorough prophylaxis so that every possible source of gingival infection might be removed.

October 7: Blood count: R.B.C., 4,900,000; W.B.C., 6,200; Hb., 85 per cent.

Rise in W.B.C. attributed to severe prophylaxis.

October 9: Blood count: R.B.C., 4,500,000; W.B.C., 5,500; Hb., 90 per cent.

Differential: Neutrophiles, 67 per cent; lymphocytes, 27 per cent; monocytes, 5 per cent.

Patient discharged feeling fine, and mouth in very good condition.

On December 27, 1935, this patient wrote from her home in New Jersey "Health is perfect, no gum trouble or tooth trouble."

CASE 2.—Dr. J. R., dentist, aged 42 years. Previous History: Admitted to the University Hospital June 14, 1932, for incision and drainage of perirectal abscess, and the recovery was uneventful. During the routine study of the case granulocytopenia was disclosed.

Blood counts: R.B.C., 2,730,000 to 3,300,000; W.B.C., 475 to 2,100; Hb., 68 to 80 per cent.

Differential: Neutrophiles, 0 to 40 per cent; lymphocytes, 60 to 98 per cent; monocytes, 0 to 1 per cent; eosinophiles, 0 to 2 per cent; myelocytes, 0 to 10 per cent.

June 28: Patient discharged.

June 28 to October 14: Practiced dentistry. He was weak during this period, but in spite of this weakness felt "pretty well."

October 5: Two teeth became "abscessed." The patient extracted one, a friend the other, under novocaine anesthesia. The socket did not heal.

October 14: Admitted to University Hospital. The mandibular right second incisor and canine removed recently. The area was "ulcerated." The sublingual tissue was swollen and edematous.

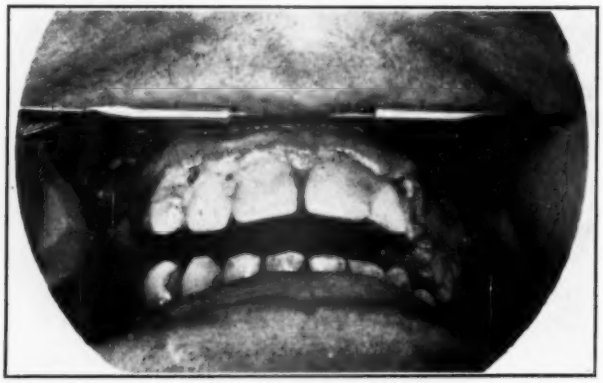

Fig. 1.—Photograph of the mouth of a patient, showing a large grayish necrotic clot in the maxillary right molar region from where two teeth were removed one week previously. There is also a severe stomatitis present, which is here demonstrable about the maxillary incisors. The diagnosis in this case was agranulocytosis.

Blood count: R.B.C., 4,000,000; W.B.C., 1,600; Hb., 75 per cent.

Differential: neutrophiles, 6 per cent; lymphocytes, 92 per cent; monocytes, 1 per cent; eosinophiles, 1 per cent.

October 16: Considerable swelling at site of extractions.

October 17: Blood count: R.B.C., 3,780,000; W.B.C., 1,125; Hb., 75 per cent.

Differential: neutrophiles, 12 per cent; lymphocytes, 79 per cent; monocytes, 5 per cent; eosinophiles, 1 per cent; myelocytes, 3 per cent.

October 18: X-ray examination of jaw: Osteomyelitis in the region of extracted teeth.

October 21: Sequestrum removed. Swelling gradually disappeared.

October 24: Blood count: R.B.C., 3,800,000; W.B.C., 950; Hb., 75 per cent.

Differential: neutrophiles, 2 per cent; lymphocytes, 96 per cent; eosinophiles, 2 per cent.

October 25: Blood count: R.B.C., 3,800,000; W.B.C., 850; Hb., 75 per cent.

Differential: neutrophiles, 1 per cent; lymphocytes, 48 per cent; eosinophiles, 1 per cent.

Patient left the Hospital.

October 26: Entered another hospital in the city and died a short time later.

CASE 3.—N. B., a Russian, male, aged 57 years. November 13, 1933: Admitted to the University Hospital, complaining of pains in all joints.

Blood count: R.B.C., 4,600,000; W.B.C., 2,200; Hb., 90 per cent.

Differential: neutrophiles, 5 per cent; lymphocytes, 88 per cent; monocytes, 7 per cent.

X-ray examination of the teeth was negative.

Infected tonsils were removed.

December 5: Discharged but not cured. Asked to return. W.B.C., 4,300.

December 5 to May 9, 1934: Improved 75 per cent in interim, while under treatment by his home physician.

May 10: Temperature 102. Patient had chill. Developed pain in left molar region.

Dentist called to patient's home. He removed molar without anesthesia because it was so "loose."

May 12: Face became swollen and pus began draining from site of extraction. Went to office of physician who drove him home and immediately sent him to bed.

May 12 to May 25: Kept in bed. Patient felt much worse since extraction.

May 25: Another tooth removed because it was very loose and painful.

May 29: Readmitted to hospital.

Left side of face swollen, eye almost closed. Difficulty in opening mouth.

There was a definite cellulitis on left side, involving maxillary sinus, with a foul discharge from site of extraction.

Blood count: W.B.C., 3,000; Hb., 82 per cent.

Differential: Neutrophiles, 44 per cent; lymphocytes, 49 per cent; monocytes, 7 per cent.

June 2: W.B.C., 2,900.

Considerable drainage from molar region.

June 4: Blood count: W.B.C., 3,000; Hb., 74 per cent.

Differential: neutrophiles, 8 per cent; lymphocytes, 88 per cent; monocytes, 4 per cent.

X-ray examination of maxilla: Osteomyelitis; cloudy maxillary sinus. Smears: Green streptococci; few nonhemolytic streptococci; M. catarrhalis; Staphylococcus albus.

June 11: Blood count: W.B.C., 2,400; Hb., 63 per cent.

Differential: Neutrophiles, 12 per cent; lymphocytes, 84 per cent; monocytes, 4 per cent.

June 14: Loose sequestrum removed from molar region.

June 25: Blood count: R.B.C., 4,200,000; W.B.C., 7,000; Hb., 86 per cent.

Differential: Neutrophiles, 76 per cent; lymphocytes, 12 per cent; monocytes, 9 per cent; myelocytes, 3 per cent.

June 26, 1934: Blood count: W.B.C., 7,600; Hb., 96 per cent.

Differential: Neutrophiles, 93 per cent; lymphocytes, 5 per cent; monocytes, 2 per cent.

Patient died. Diagnosis: ruptured pulmonary abscess.

Note.—On previous admission patient had complained of arthritis, presented a splenomegaly and a leukopenia. He was discharged to his home physician and continued to show improvement at home until a tooth was removed in May, 1934, following which he developed cellulitis and osteomyelitis of the left maxilla. Treatment of this was the occasion of the present admission (May 29, 1934). On June 12, 1934, he developed pulmonary complications and died June 26.

Amidopyrine as a Factor.—For years pharmaceutical manufacturers, physicians' supply houses, and laboratories that manufacture dental preparations have made it a practice to send complimentary samples of secret proprietary mixtures containing amidopyrine to dentists. It is probably true that dentists have indiscriminately prescribed these preparations for postoperative pain following the extraction of teeth, often probably being guilty of giving the preparation to the patient in the original box in which it arrived, which no doubt has played some part in educating the patient to use them for headaches, et cetera. Because of the danger of self-administration, a number of state health departments have limited the sale of a great many amidopyrine combinations to prescriptions from physicians and dentists.

The Council on Pharmacy and Chemistry, of the American Medical Association,[12] in reply to the question: "Is amidopyrine primarily responsible for the production of granulocytopenia?" replied "As far as can be learned from evidence at hand, there can be no question that amidopyrine is very important in the production of granulocytopenia. In fact, no other agent has been found, either chemical or bacterial, which had been a factor in causing so many attacks."

Kracke[13] reported 11 cases in which the clinical onset of agranulocytosis was preceded by prolonged and intensive administration of drugs containing the benzene group and, also, that the disease is more prevalent among physicians and their relatives, nurses, hospital employees, and members of the allied professions than in any other group of people in the United States.

Fitz-Hugh,[14] in studying a series of 26 cases, found that there was a high incidence of patients closely related to the practice of medicine: one dentist, one dentist's daughter, one registered nurse and one student nurse, one physician's mother, one physician's father-in-law, one physician's husband, two cousins of physicians, and one physician's wife. In this group of 26 patients 17 were known to have taken amidopyrine just before or during the disease.

Madison and Squier[15] reported a series of 13 cases of granulocytopenia which they concluded were probably due to the use of "benzene chain derivatives." They called attention to the fact that all of the 13 patients were physicians, nurses, or patients who were under a physician's care before the granulocytopenia developed.

Watkins[16] reported that out of 32 cases of primary granulocytopenia which were observed at the Mayo Clinic, 24 patients had taken amidopyrine, or a derivative of barbituric acid, for varying periods before the onset of the granulocytopenia. One patient who suffered from migraine, for relief of which amidopyrine was taken, had 12 attacks of granulocytopenia, each attack following the use of the drug, and after discontinuance the agranulocytosis had not occurred.

Randall[17] had, as a patient, a woman physician, aged 25 years, who developed an acute and alarming leukopenia following the use of barbiturates and amidopyrine for the relief of simple headache.

Seemann[18] believes that amidopyrine or its combination played a part in the origin of agranulocytosis in 13 cases out of 36 that he saw in 1928 to 1933 because the patients had taken large doses of the drug.

Holten, Nielsen and Transbol[19] reported 5 fatal cases, all women, in which agranulocytosis developed during hospitalization for other disorders. The only point of similarity in the history of the patients was found to have been treatment for a longer time with amidopyrine.

Hoffman[20] and his associates reported that of 14 consecutive cases seen, the only common factor was that 12 of the patients had ingested amidopyrine. They report in detail one case that is extremely interesting: "Under our very eyes, our fourteenth patient recently developed the disease. A man, aged 58 years, was admitted to the Santa Fe Hospital for otitis media, November 27, 1933. The temperature was normal. The W.B.C. numbered 6,000, with 58 per cent polymorphonuclear leukocytes. A suppurating mastoid developed, and on December 18 a mastoidectomy was done. During the following thirty-six days he received a total of 75 grains (4.9 gm.) of amidopyrine for headache. January 23, 1934, he developed a sore throat and temperature of 103.4. His leukocyte count on that day was 1,500, with 3 per cent polymorphonuclear cells. He died January 27, in spite of vigorous therapy with pentnucleotides and liver extract. His leukocyte count dropped to 450 cells, with an absence of neutrophiles, before death."

Herz[21] pointed out that the increase in the prevalence of granulocytopenia closely parallels the increase in the use of amidopyrine.

Amidopyrine[12] was prepared by Stolz in 1893 and was patented in 1897 under the proprietary name pyramidon. Pyramidon has been on the American market for at least twenty-five years. Under the pharmacopeial designation "amidopyrine" the drug has been marketed by American manufacturers for approximately twelve years. The introduction, more than ten years ago, of two widely advertised proprietary combinations of amidopyrine with a hypnotic drug of the barbituric acid series (allonal and peralga) was followed by the marketing of a number of preparations of this type.

CONCLUSIONS

It is known that attacks of agranulocytosis may be precipitated by the extraction of teeth. It may be the anesthetic or it may be the administration of preoperative or postoperative sedatives which bring on these attacks.

It is also known that oral lesions in the form of acute gingivitis usually precede the attack.

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(To be continued.)

CYSTS OF THE JAWS INVOLVING IMPACTED TEETH

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CYSTS of the jaws involving impacted or unerupted teeth are known as dentigerous or follicular cysts . Their etiology is probably due to the proliferation of the cells of the enamel organ.[1] These cells are of epithelial origin and form around the sac of an unerupted tooth.

The tooth may be completely incapsulated within the cyst, though often the cyst is found to involve only a portion of the tooth. The part usually involved is the coronal portion, as is shown in Fig. 1. The tooth may be well formed, or

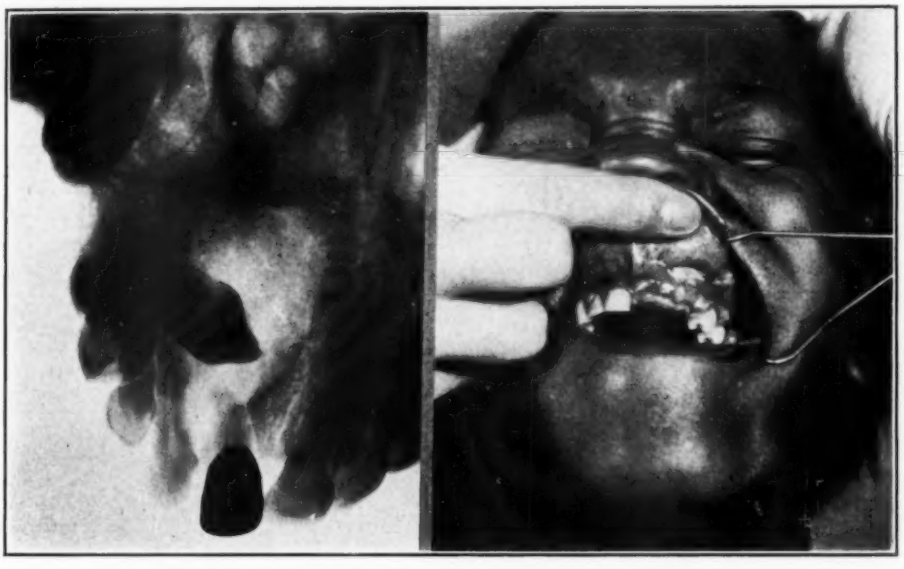

Fig. 1. Fig. 2.

Fig. 1.—Roentgenogram showing dentigerous cyst of left maxilla around crown of impacted cuspid. Complaining of pain in left side of face and maxilla, patient was hospitalized. Cyst was removed from lingual surface. Tooth was removed from labial surface. Maxillary left central and lateral incisors were removed. Lingual flap was sutured in place and iodoform gauze placed in cavity from labial. Nitrous oxide and ether used.

Fig. 2.—Same case as shown in Fig. 1, one week following operation. Shows labial incision and cavity packed with iodoform gauze.

there may be several small supernumerary teeth present; however normal permanent teeth are usually found within the cyst. Brophy reported only twelve cases in which deciduous teeth were associated with dentigerous cysts.[2]

Within the cystic sac or capsule is also found a substance that may vary from a straw-colored, viscid, stringy fluid to an almost solid matter resembling oatmeal. This substance often contains cholesterin crystals.

Due to the fact that these cysts cause no pain they may become very large before being noticed. They may be found at any age but occur most often in young adults.

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The diagnosis of a dentigerous cyst is usually very easy especially when roentgenograms are made. A swelling of the bone is present as is a thinning of the outer bony wall which crepitates when palpated and produces a sound resembling the crackling of an egg shell. If one of the permanent teeth is missing and there is no history of extraction, a dentigerous cyst should be suspected if any of the aforementioned symptoms are present.

The x-ray pictures will show an area of definitely destroyed bone forming a cavity or cavities within the bone associated with an impacted or supernumerary tooth or teeth. If more than one cavity is found, the x-ray picture will show that the cavities are separated by "thin fibrous or bony septa and they may or may not communicate."[3] This type of cyst is known as a multilocular dentigerous cyst (Fig. 3).

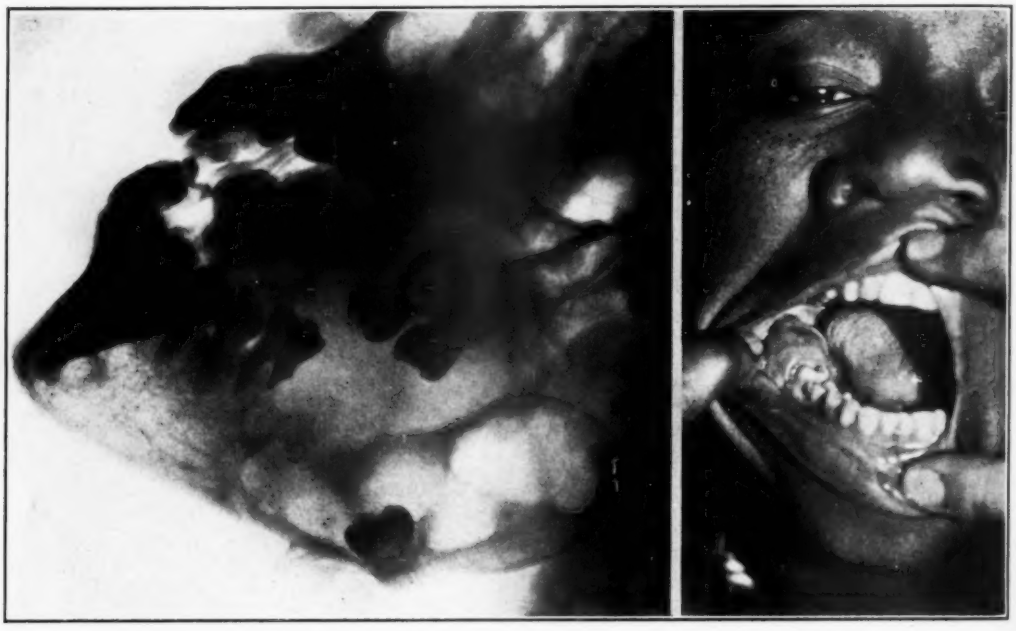

Fig. 3. Fig. 4.

Fig. 3.—Negro female, age 26 years. Multilocular dentigerous cyst of mandible.

Fig. 4.—Intraoral photograph of patient in Fig. 3. Patient has no pain, but right third molar area is sore and tender; has had "abscess" opened several times but each time "it comes back."

Blair and Ivy state that in the maxilla these dentigerous cysts may push up into the maxillary sinus in a domelike manner and encroach upon the space normally occupied by the latter, as in Fig. 5; however they seldom break through the sinus.[4]

Ordinarily these cysts do not become infected. If they are mistaken for an abscess of the jaw and incised or punctured for drainage, a severe inflammatory condition and suppuration may occur due to the break of the mucous membrane of the oral cavity. This condition should be cleared up before the cyst is removed.

Most dentigerous cysts can be removed intraorally. Silverman's technique is followed. An incision is made at the lateral aspect of the cyst starting at the

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 9.

Fig. 8.

Fig. 10.

Fig. 5.—E. M., negro female, age 17 years. Large dentigerous cyst of maxilla. Duration known to be two years.

Fig. 6.—Occlusal x-ray picture of patient in Fig. 5, showing bone destruction.

Fig. 7.—Roentgenogram of patient in Fig. 5, showing outline of cyst with impacted cuspid.

Fig. 8.—The cyst of patient in Fig. 5 removed, showing the impacted cuspid which was within the cyst.

Fig. 9.—Cyst of patient in Fig. 5 removed under nitrous oxide and ether. Intraoral cavity packed with iodoform gauze.

Fig. 10.—Patient in Fig. 5, six months after removal of cyst.

Fig. 11. Fig. 12.

Fig. 11.—Negro female, age 12 years. Impacted central incisor with an apparent cyst sac forming around crown of tooth. No complaint.

Fig. 12.—Miss M. W., white female, age 35 years. History of impacted cuspid removed four years before; crown of cuspid was not removed. Radiogram shows a definite cyst sac around the crown. This was removed from the labial surface.

Fig. 13. Fig. 14.

Fig. 13.—F. L., white, age 9 years. Cyst of right mandible involving unerupted first and second bicuspids. Cyst probably originated from infected mandibular right deciduous second molar. Cyst including unerupted teeth was removed in hospital under nitrous oxide and ether anesthesia. Cavity was packed with iodoform gauze.

Fig. 14.—Same case as Fig. 13. Showing iodoform gauze dressing within cavity.

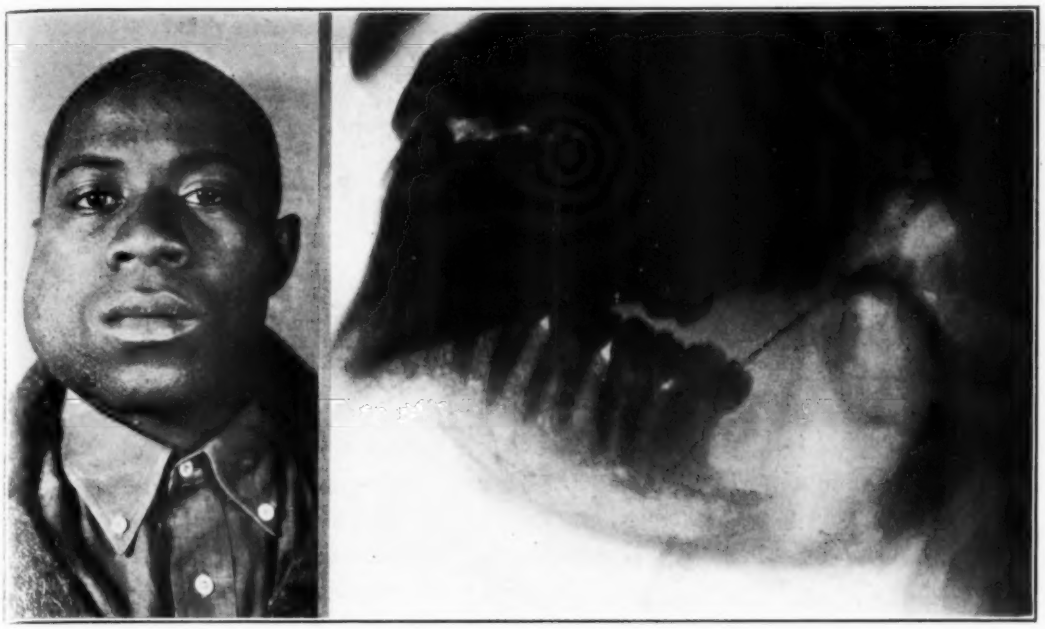

Fig. 15. Fig. 16.

Fig. 15.—R. L. H., negro boy, age 17 years. Complained of swelling of jaw and toothache. Was unable to designate ailing tooth. There was a pericoronal infection around unerupted third molar which was cleared up before operation. Nitrous oxide and ether were used.

Fig. 16.—Roentgenogram of patient in Fig. 15. Showing large cyst of ramus of mandible associated with crown of partially erupted third molar.

Fig. 17. Fig. 18.

Fig. 17.—Miss P. H., white, age 16 years. Large dentigerous cyst of mandible. Nitrous oxide and ether anesthesia used.

Fig. 18.—Same case as Fig. 17, after regeneration of bone.

posterior extent and bringing the scalpel forward to the anterior part of the growth. The incision is curved in order to expose the area involved.

The mucoperiosteum is then dissected from the bony wall, which is usually very thin. The mucoperiosteal flap is held back with retractors while the outer bony wall is removed with curved scissors or rongeurs. In smaller cysts it may be necessary to remove the bone with chisels. If the cyst sac is ruptured the contents should be aspirated and the cavity sponged out. The cystic sac or membrane is seen lining the bone cavity. This membrane is then dissected out, using the periosteal elevator and curettes. The unerupted tooth, to which the membrane is attached, is removed with the sac, as are all the teeth whose roots are resorbed or found exposed.

The cavity is packed with iodoform gauze and the incision is sutured only where it is curved. At the end of forty-eight hours a few inches of the gauze are removed, and the mouth is irrigated with a warm saline solution. The patient is seen again after twenty-four hours. More gauze is removed and the irrigation of the mouth repeated.

This treatment is continued until all the gauze has been removed. Granulation tissue soon begins to fill in the cavity, and later regeneration of the bone occurs (Fig. 18).

The roentgenograms and photographs shown in Figs. 1 to 18 are taken from my own records and case histories.

CONCLUSIONS

A dentigerous cyst may involve either the upper or the lower jaw. One or more teeth must be present within the cyst sac. The cyst may form more than one cavity within the bone.

Of doubtful origin, such a cyst is probably due to the proliferation of the enamel organ. This type of cyst is usually found in young adults.

The diagnosis is comparatively easy to make because of the swelling and crepitation of thinned bone. It is unmistakable when roentgenograms are made because of the definite area of destroyed bone associated with an impacted or unerupted tooth or teeth.

The intraoral approach and complete enucleation of the cyst sac with the tooth or teeth involved is the operation preferred.

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TREATMENT OF COMPLICATIONS OF SURGICAL DISEASES OF THE MOUTH*

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IF IT were not for the complications that occasionally arise following operations, surgical practice would be comparatively simple and many worrisome days and sleepless nights would be avoided. Even when operations are performed under the most favorable circumstances, unforeseen emergencies arise occasionally, and the operator must be prepared to handle them. This applies to operators in oral surgery just as much as to operators in general surgery, and no one should attempt operations on the mouth and jaws, even the extraction of a tooth, unless he is fully alive to the complications that may arise and is prepared to follow the case and at least see that the patient gets into competent hands. Occasionally we are called to see a patient suffering from hemorrhage following tooth extraction where the operator has dismissed the patient from his office and upon being called up later on account of secondary bleeding has told the sufferer he does not see patients outside of office hours and to get in touch with a physician. This lack of responsibility is not common, but is more frequently encountered than it should be. The dental surgeon should be just as much prepared to follow up his case in emergency as is the general surgeon.

The three commonest complications of surgical conditions about the mouth in order of urgency are: (1) hemorrhage, (2) pain, and (3) infection.

HEMORRHAGE

Undue bleeding following an operation or an injury requires attention more urgently than anything else, because loss of blood will have deleterious effects more rapidly and if persistent may eventually be fatal. Other complications take more time to develop or do not endanger life, and therefore combative measures can be delayed or carried out slowly. From the clinical standpoint, hemorrhage may be classified as (a) primary or immediate; (b) intermediate, i.e., occurring within the first few hours, from dislodgment of a blood clot, failure of packing, etc.; (c) secondary, occurring after forty-eight hours or more, due usually to infection or sloughing. Bleeding may be arterial, venous, or capillary, according to the vessels involved. In arterial hemorrhage the blood is bright red in color and emerges from the vessel in jets or spurts synchronous with the heart beat. In venous hemorrhage the blood is dark red in color and flows continuously. In capillary hemorrhage there is a general oozing from small vessels. Much future grief can be avoided by care in seeing that any important bleeding has stopped before the operation is completed. In operations in the mouth, as a rule, only small vessels are cut. Cut arteries and veins, when in the soft tissues, when they

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can be identified, are clamped with hemostatic forceps and tied with catgut. Much future trouble will be saved if this be done during the operation instead of relying on pressure from packing. For capillary oozing pressure packing with gauze will usually suffice. Bleeding from vessels in bony canals, such as the inferior dental artery, usually stops spontaneously by retraction of the vessel in the canal, but if not, can generally be controlled by packing the cavity with gauze. Sometimes in spite of all precautions, although the patient may leave the chair or the operating table with a dry wound, after a few hours bleeding will start. The commonest type of hemorrhage in the mouth is, of course, that resulting from tooth extraction. It is very good practice, and I believe this is now being quite regularly followed by exodontists, not to allow the patient to rinse with a mouth wash immediately after the extraction of a tooth because this tends to prevent coagulation of blood in the socket, but to favor formation of a clot by placing a gauze pad over the site of extraction and having the patient make gentle pressure for a few minutes by biting on the pad. The patient may be dismissed after the extraction with an apparently firm clot in the tooth socket, but in a few hours profuse bleeding may start, giving rise to considerable alarm. On examination large clots may be found in the mouth. The first thing to be done is carefully to remove the clots in order that the exact source of the bleeding may be seen. It should be ascertained as accurately as possible whether the hemorrhage arises from lacerated gum edges, from the margins of the socket, or from the depths of the socket. If a cut or torn vessel can be seen spurting blood from the gum edge, it should be caught with hemostatic forceps and tied with a 00 or 000 catgut ligature. Bleeding from the margin of the socket calls for a catgut suture to draw the gum margins together. The pressure thus obtained will usually be sufficient to arrest the bleeding. If coming from the depths of the socket the hemorrhage can generally be stopped by packing. Sometimes the socket will be sufficiently retentive to hold the packing firmly. If the bleeding still continues, then a pad of gauze should be laid over the packing in the socket and pressure brought to bear by occlusion with the opposing teeth. Sometimes with a few minutes of biting on the gauze by the patient, the bleeding will stop. If this does not succeed, we have nearly always checked the hemorrhage by holding the teeth of the two jaws together with wire ligatures, just as in a case of fracture. In obstinate cases the wire fixation in occlusion should not be released for two or three days, even at the risk of infection and delay in healing. Dozens of forms of medication have been suggested as hemostatics, to be applied locally on packing, such as adrenalin, thromboplastin, Monsell's solution, tannic acid, coagulen, etc.; but all are greatly inferior to mechanical pressure in the presence of real hemorrhage, and we have long ago discarded them all. What has been said applies to otherwise healthy individuals, and not to people suffering from blood dyscrasias—hemophilia, leukemia, purpura, etc. In these cases the condition should be ascertained, if possible, before any operation is undertaken. No patient known to be suffering from a blood dyscrasia should be operated on without preliminary treatment to lessen the tendency to hemorrhage; and no operation, even a minor one, should be performed on these patients outside the hospital, where all facilities are available for coping with emergencies. Severe

hemorrhage during or following major operations on the jaws can be prevented by preliminary ligation of the external carotid artery. In a few cases this has to be resorted to in order to check secondary hemorrhage following tooth extraction or other operations in the mouth.

Stubborn hemorrhage from the palatine artery sometimes occurs as a result of laceration of the gum on the palatal side in removal of maxillary molars or premolars. More than once I have seen persistent bleeding from this source where the exodontist has deliberately made a cut in the gum across the artery in order to obtain better exposure of the lingual root of the tooth to be extracted. It may be quite difficult to control such hemorrhage, as the usual gauze pressure cannot easily be applied and maintained over this area. Grasping the bleeding end of the vessel with forceps and applying a ligature is also usually next to impossible. A deep suture through the gum back of the bleeding point tied to embrace the vessel may be successful. If this fails, a flap of mucoperiosteum beginning at the bleeding point should be dissected up, and then the artery can usually be seen on its under surface, clamped and tied. As a final resort, the flap can be raised until the artery is seen emerging from the posterior palatine foramen, and the latter plugged with a stick of wood.

Hematoma is a collection of blood in the tissues, due to subcutaneous or submucous rupture or puncture of a vessel. It may occur postoperatively from bleeding into a closed wound. One of the most frequent causes about the mouth is puncture of a vessel during injection of a local anesthetic, particularly in the region of the tuberosity of the maxilla. It is manifested by a rapidly increasing swelling of the soft tissues immediately following the injection. Usually the swelling is self-limited, as the pressure of the tissues on the punctured vessel causes the flow of blood to stop. At first there may be no departure from the normal color of the parts, but in a few days as the blood infiltrates toward the surface there is a black and blue discoloration. These symptoms are naturally alarming to the patient and the discoloration is annoying, but usually there is only temporary discomfort without serious consequences. The application of cold and pressure may help to limit the swelling, which gradually subsides as the blood is absorbed. Occasionally the collection of blood becomes infected, giving rise to symptoms of acute inflammation. If pus forms, incision and drainage of the swelling are indicated. If a considerable collection of blood is present in the tissues, the disappearance of the swelling may sometimes be aided by aspiration of the fluid. Hematoma in a sutured wound usually calls for removal of some of the sutures and evacuation of the fluid or clotted blood.

PAIN

Postoperative or posttraumatic pain is due to various causes, and this fact of course has a bearing on treatment. Very little will be said about the control of pain per se. As a general rule pain following bone trauma is greater than that in cases where the soft tissues alone are involved. Postoperative bone pain is less, as a rule, where the bone has been subjected to the minimum amount of trauma. It can also be minimized by covering over exposed bone as far as is practicable with soft tissue flaps sutured across. Local sedative applications are seldom effective for more than a very brief period, but a protective covering for

exposed bone where flaps are not practicable will often be soothing and promote healing. One of the most useful of these is the so-called wonderpack paste suggested by Ward. This is a proprietary preparation, the active sedative principle of which is eugenol. The powder contains zinc oxide, resin, and probably some powdered asbestos. The powder and liquid are mixed into a thick paste which gradually hardens and forms a sort of cement. We have found it very valuable in painful postoperative cavities in the bone after cyst operations, removal of impacted teeth and so forth, where soft tissue closure has not been possible or where a blood clot has not filled in the cavity. This has a sedative effect and also forms a dressing which may be safely left in place for several days without inviting infection such as would happen with gauze. The fact that it does not have to be disturbed frequently encourages healing to go on beneath it.

Postoperative pain due to the trauma of operation may be mitigated by cold applications. In other cases heat externally may be of value. For minor degrees of pain five or ten grains of aspirin by mouth, repeated in two or three hours, will suffice. Or a combination of aspirin and phenacetin, five grains each, may be more effective. Codeine, gr. ¼, may be used in cases of moderately severe pain. For severe pain, generally nothing less than morphine hypodermically will be effective. If the pain is due to infection, then measures to combat the latter will have a beneficial effect on the pain.

INFECTION

Much can be done to minimize postoperative infection by having the mouth in as clean a condition as possible before operation. Here, again, gentle handling of the tissues will contribute a good deal to the avoidance of infection. I believe the current use of the compressed air spray in freshly opened tooth sockets may be responsible for some of the postextraction troubles, bacteria being thereby forced deeply into previously healthy tissues. A very common term that nearly always enters a discussion of this kind is "dry socket"; like many other catchwords that enjoy a run of popular parlance (Vincent's infection, trench mouth, traumatic occlusion, are other examples) it is often misapplied. I presume what is usually meant by this term is a failure of the blood to flow into and coagulate in the socket of an extracted tooth, the bony walls being thus left uncovered, and severe pain is experienced by the patient. It is my observation that this condition chiefly follows extraction of teeth which have been pulpless for a long time and whose roots are surrounded by dense, poorly vascularized bone. The density of the bone prevents the free flow of blood from it into the tooth socket, so no clot forms. Such teeth are often very difficult to dislodge, and the additional trauma required in their removal contributes to the condition. Chances of occurrence of this very disagreeable sequel to extraction can often be lessened by removal of some of the dense bone around the socket of the tooth with a chisel so that the tooth can be extracted with little trauma. Various forms of treatment have been suggested to relieve the condition after it has developed. I see no advantage in curetting these sockets, and this may only add to the discomfort of the patient. The socket should be gently cleaned out by syringing with warm solution, and after drying, a small amount of the eugenol paste is lightly inserted. This will

often ease the pain and will afford protection. Severe pain must be controlled by sedatives taken internally. I believe we can do no more than this except wait until the acute discomfort subsides, which may require several days. The condition will eventually resolve either by gradual vascularization of the bone surrounding the socket or a thin shell of sequestrum will form and come away.

One of the complications of a dentoalveolar abscess or of a fracture of the jaw is cellulitis of the surrounding soft tissues. In most dentoalveolar abscesses the pus perforates the bone opposite the root of the tooth and points beneath the gum in the vestibule of the mouth. But there are anatomical conditions which may modify the usual train of events. On the outer side of the maxilla and the mandible the attachment of the buccinator muscle and on the lingual side of the mandible the attachment of the mylohyoid muscle may be important factors. In the maxilla, from the molars and premolars, the maxillary sinus may be invaded. Abscesses from the maxillary teeth occasionally point on the palate. From the incisors, the floor of the nose may be perforated. The usual abscess from the maxillary molars, premolars and canine points beneath the attachment of the buccinator muscle and appears in the vestibule of the mouth. If the pus perforates above the buccinator attachment, it will travel toward the skin of the face. In the mandible, if the perforation takes place high up, through the outer alveolar plate, the swelling will be in the vestibule of the mouth. If the body of the bone is perforated beneath the buccinator attachment, the abscess will appear beneath the skin above the border of the jaw or in the submaxillary region. A subperiosteal abscess starting from a molar may burrow backward and upward along the ascending ramus of the mandible and point above the zygoma. The course of a dentoalveolar abscess from a mandibular tooth pointing lingually varies according to whether the perforation is above or below the attachment of the mylohyoid muscle. If above, the swelling will appear in the floor of the mouth beneath the tongue; if below, the swelling will be in the submaxillary region. Abscesses arising around the mandibular third molar sometimes point in the region of the anterior faucial pillar, simulating peritonsillar abscess.

Acute dentoalveolar abscess requires the same treatment as any other abscess, i.e., prompt drainage. Before frank suppuration occurs, it is unwise to attempt to bring the pus to a head by the application of flaxseed poultices or hot water bottles. These tend greatly to increase the inflammatory process, encouraging an abscess to point externally that might otherwise undergo resolution or open in the mouth, or favor the development of osteomyelitis from pus confined in the bone. Cold moist applications of saturated solution of magnesium sulfate or boric acid and alcohol are more suitable in the preliminary stages. Patients with acute dentoalveolar abscesses frequently suffer from lack of cooperation of physician and dentist. The physician sends the patient to the dentist for removal of the offending tooth, while the dentist hesitates to extract the tooth in the acute stages. The dentist is usually blamed if complications arise, regardless of the course he pursues. If he extracts an acutely abscessed tooth and bone infection or cellulitis occurs, it is frequently claimed that the extraction caused the infection to spread. If he does nothing, and complications follow, he may be accused of negligence. The real negligence in most of these cases lies

with the patient, or the parents if the patient is a child, for permitting the dental disease to progress so far without seeking attention. The question of extraction of the tooth during the acute stage of inflammation has been well summed up by Blair. He calls attention to the occasional aggravation of the infection and sometimes death from general sepsis following this procedure, and he advises postponement of the extraction until after the acute symptoms have subsided. I believe that each case calls for the exercise of judgment as to just when the tooth should be removed. The principal point, when the presence of pus is suspected, is to establish drainage early by incision through the periosteum. If the abscess points into the mouth, it may be drained by an incision through the gum close to the bone. It is usually unnecessary to insert drainage material, but if desirable a small strip of rubber dam may be placed in the incision. This should be followed by frequent use of a hot mouth wash. Most abscesses from the maxillary teeth may be drained through the mouth. Drainage of a dental abscess with cellulitis pointing extraorally is best effected by incision through the skin under gas anesthesia. The skin is incised with the knife, and the deeper tissues are separated by blunt dissection with scissors until the pus is reached. Rubber dam or tube drainage is usually required for several days. The incision should be planned to drain the abscess at its most dependent point; it should be adequate, but not larger than necessary; it should follow the natural lines of the skin, and be so placed that the resulting scar will be concealed as far as possible; it should avoid severing important structures. For example, the incision for drainage of a submaxillary abscess should be made well beneath and parallel with the lower border of the mandible, in front of or behind the position of the facial artery, according to the place of greatest pointing. Incisions above the lower border of the mandible should be avoided if at all possible. Where the pus has traveled up over the ascending ramus, a single incision beneath the angle of the mandible may suffice, and a drain inserted on the outer or the inner surface of the ramus as the case may be. In more severe cases it may be necessary to make a counter incision horizontally or obliquely above the zygoma, and connect the two incisions by through-and-through drainage beneath the parotid gland. These incisions avoid damage to facial nerve branches and parotid gland and duct, and the resulting scars become practically unnoticeable after a short time. After the acute symptoms have subsided, the tooth originally causing the trouble should be extracted in order to avoid recurrence or the persistence of a discharging sinus.

OTHER COMPLICATIONS

Fracture of a considerable portion of the alveolar process or of the body of the bone itself may occur during the extraction of teeth. In removal of maxillary molars, the entire maxillary tuberosity may come away with the tooth. If the alveolar process is entirely detached from its soft tissue connections, no attempt should be made to save it; but, if a large important piece of bone has been loosened and still has a broad attachment to the overlying gum, an effort may be made to save it by suturing the gum over it. Complete fracture of the mandible occurred as a complication of tooth extraction in 5 of 100 consecutive cases of fracture of the mandible. Most of these were cases of impacted third molar.

It is surprising that the mandible is not more frequently fractured during this operation, judging from the force that is sometimes used, but where the bone has been weakened by disease the operator is not necessarily to blame.

Maxillary Sinus Complications. In extraction of maxillary molars and premolars, an opening through the socket into the maxillary sinus is not infrequently produced. This opening may be the result of previously existing disease, or due to unavoidable fracture of the extremely thin plate of bone between the root end and the sinus. I believe the latter occurs much more frequently than is suspected. It is fortunate that the accident is generally not suspected, because meddlesome treatment is thus avoided, and the opening heals of itself. So, if such a rupture is suspected, and there is no evidence of disease in the maxillary sinus or around the end of the root, it is best to let matters strictly alone. I advise against probing or irrigation of the sinus through the opening. Do not pack the socket unless there is much hemorrhage, but encourage the formation of a blood clot in it by putting a gauze pad over it for several minutes, and then possibly suture the gum edges together. The chances are that no further trouble will occur, whereas if probing and irrigation are carried out, infection of the sinus will almost surely follow.

If an opening into the antrum persists following extraction of a tooth, with suppuration in the sinus, then appropriate treatment of the latter should be instituted, preferably through the nose, and never by enlarging the tooth socket. After the infection in the sinus has cleared up, if the opening through the socket does not close spontaneously, it may be closed by a suitable gum flap operation.

Many other complications of surgical conditions of the mouth and jaws could be mentioned, but in the time at my disposal I believe that the most important points have been covered.

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A PROCEDURE FOR NITROUS OXIDE ANESTHESIA

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PAST experience if properly evaluated becomes the best teacher. This, together with personal contact with many dentists, leads me to submit this paper. Several of the points outlined are so elementary that many anesthetists fail to give them proper consideration. Frequent inventories to insure that no detail be slighted will result in better and safer anesthetics.

PREOPERATIVE PROCEDURE

Efficient Equipment.—Have an efficient anesthetic equipment with which you are familiar and be sure it is in good working condition. A fine dust forms upon the outlet screens of the machine when in continuous use. These outlets should be cleaned periodically. On the other hand, rubber will deteriorate very rapidly and become leaky upon the machine that is not used frequently. Either of these conditions will prevent the administration of a satisfactory flow of gases. Always make sure that you have an adequate supply of nitrous oxide, carbon dioxide, and oxygen. An anesthetic death occurred in a hospital because oxygen was not immediately available when the supply ran out on the machine. A verdict for heavy damages against the physician was given in this case.[1, 9]

Mouth Props.—A cone screw of hard rubber for opening the jaws is needed for emergencies. Another is of the rachet type with flat wings that can be covered with rubber tubing to protect the teeth or gums that it contacts when it is placed in the mouth; this prop will open the mouth and maintain the opening needed for operative procedure. The Heidbrink type of prop is also very useful intraorally. It should have a string attached that hangs well out of the mouth. Great care should be exercised to prevent the lips from being traumatized between the teeth and the mouth prop. Such an injury may cause the patient more postoperative distress than the operation. The selection of the proper mouth props may determine the success or failure of both anesthetic and operation. Broken or loosened teeth, injured by the mouth prop, rank high among the causative factors that terminate in law suits.

Restoratives.—Recommended restoratives should be kept in a place, set aside for that purpose only, which is readily accessible in the event of an emergency.

Respiratory Stimulants:

Carbon dioxide in a cylinder attached to the gas machine provides one of the best stimulants to increase the rate and volume of the respiration.

Oxygen, of course, in ample quantity has already been stressed. This together with artificial respiration makes an absolutely essential combination.

Read before the Oral Surgery Section of the Southern California State Dental Association Meeting, Sept. 13, 14 and 15, 1937.

Aromatic ammonia as an inhalant stimulates both heart and respiration.

Cardiac Stimulants:

Strychnine sulfate produces a strong slow heart beat and also stimulates respiration.

Caffeine sodium benzoate dilates the small vessels, produces a strong rapid pulse, and relieves coronary thrombosis.

Epinephrine hydrochloride contracts the small vessels and increases the blood pressure. In complete heart stoppage 1 c.c. may be injected directly into the heart.

Premedication.—Premedication is desirable in the athletic, plethoric, and neurotic types. Those who work with volatile gases such as gasoline or turpentine also need heavy premedication.[2] Nembutal, one of the short acting barbiturates, in doses of 1½ to 3 gr. is very satisfactory for this purpose. Desmarest[3] of France and John W. Seybold[4] of Denver stress proper evaluation and treatment of psychic fear. Seybold resorts to a procedure that includes the playing of instrumental music by phonograph. Any patient who has been premedicated may be befuddled for hours and not safe to be ambulatory. Some competent adult should accompany the patient.

Physical Examination.—Few dentists are competent or equipped to make a thorough physical examination of the prospective patient, but there are a few essential points that may be ascertained to determine the advisability of giving an anesthetic.

Study the general physical tone, size, weight, color, etc. When has the patient last been examined? What findings? If recent, call the examining physician if possible. Ask the patient what his ailments are. What treatment has been and is being given? What is the status of same at the present time?

Heart:[3, 5] Has the patient any known heart trouble? Does exercise exhaust him and cause shortness of breath? Are the lips blue from cyanosis? Is the breathing labored without exertion? Are the ankles swollen, indicating a congestive heart failure? What is his occupation? Is he able to do his work as well as the average person of his age, etc.? Are there any chest pains or distress in the elbows to indicate angina pectoris? Obtain the family history on this point. The pulse will probably be increased to 100 or even 120. If full and regular, this is a good sign, but if totally irregular, it may indicate auricular fibrillation. This type of person should have a course of treatment with digitalis before being considered for an anesthetic. What is the blood pressure? If there is a hypertension, but not sufficient to contraindicate a necessary anesthetic, try to avoid all struggling and cyanosis, either of which may suddenly increase the blood pressure. Premedication is usually indicated. Is there any anemia? If so, what type and what is its progress? If the anemic patient is given an anesthetic, carry a very high oxygen flow, augment with carbon dioxide, if needed to maintain active respiration.

Raisbeck[5] offers the following suggestions relative to cardiac risks in dental anesthesia: "With mitral stenosis avoid irritating anesthetics, such as ether, as they cause congestion. Ventricular fatigue may result from increasing the blood pressure during cyanosis or struggling in cases of hypertension. Auricular fibrillation is indicated when there is a totally irregular

pulse. Minor irregularities usually disappear under the acceleration of the pulse resulting from a visit to the dentist; therefore, if the accelerated pulse is noticeably irregular, it is well to postpone the anesthetic until the patient has had a course of treatment with digitalis. Angina pectoris has the characteristic chest and elbow pain. It may also be indicated by the patient being awakened with a pain in the night. This occurs when the blood pressure drops during sleep and the coronary arteries fail to get enough blood to nourish the heart."

Lungs: Are there any bronchial irritations? How chronic and how severe? Acute infections such as colds, flu, streptococcic sore throat, or active tuberculosis contraindicate an inhalation anesthetic. Is there any asthma or endocrine disturbance? What is the metabolic rate? If not, a more careful examination is in order. Respiratory embarrassment may be of a physiologic or mechanical nature. It may be caused by enlarged tonsils and adenoids, inflammatory swellings and tumors of the neck exerting pressure on the trachea, depression of the mandible, foreign bodies, improper position of the oropharyngeal pack, or excessive saliva, mucus and blood. The airway must be kept clear if a satisfactory anesthetic is to be given.[2]

Kidneys and Bladder: Do the kidneys and bladder function satisfactorily? How much water is consumed per day? How much urine voided? Does it bother at night? How much alcohol is consumed? Are the ankles or other parts of the body edematous? What is the history of the urinalysis, if any?

Bowels: What is the food intake and elimination? Is the patient toxic? If so, why?

If you are not satisfied with the physical picture presented, it is the part of wisdom to request a complete physical examination by a competent physician.

Metabolic Rate: Guedel,[6] in his excellent book *Inhalation Anesthesia,* Part I, Chapter V, points out that the higher the metabolic rate above normal, the more difficult to carry the patient down to surgical anesthesia. Hyperthyroidism, fever, pain, and emotional excitement, each tends to increase the rate. Premedication and, if necessary, the use of a synergist that is more potent than nitrous oxide are indicated. Ether or anesthol serves this purpose. The continuous flow of straight nitrous oxide for many seconds is dangerous in that it produces an anoxemia[7] and may, if carried too far, cause brain tissue changes or even an immediate fatality. The anemic, debilitated or toxic patient may be so handicapped that the oxygen supply of the body is far below normal, and unless a marked increase in the oxygen supply is given anoxemia will occur with its undesirable sequence. The usual signs of anoxemia are an increase in the rate and depth of breathing—active dyspnea, the cyanosis, clonic muscular spasms, and there may be convulsive vomiting, and finally cessation of respiration and heart action—asphyxia. The anemic type may show no dyspnea or pronounced cyanosis, but will fade out without any active reaction. These patients need careful handling and must be watched every minute, because of the lack of symptoms to warn of danger. They are particularly resistant to any effort of resuscitation because their vital forces have long been depressed.

Nitrous oxide is the general anesthetic of choice for the dental office according to the expressed opinion of most authorities.[8] Most general anesthetics, including the recently developed evipal and avertin, are more properly handled with hospitalization. The principal contraindications to nitrous oxide are tuberculosis, acute and subacute bronchial disease, heart disease, diabetes, and nephritis.[8]

OPERATIVE PROCEDURE

Assuming that your equipment is in good order and ready for use and that the patient is a good anesthetic risk, make sure that there has been no food intake for at least four hours. An early morning appointment, with no breakfast preceding, is preferred. All authorities on anesthesia stress this point. Guedel[6] and Lawrence[7] in recent publications emphasize the necessity of avoiding the aspiration of vomitus, for it is very apt to result in immediate asphyxia or, if this is not the end, a postoperative pneumonia or lung abcess may follow. Guedel cites a number of such cases in his book. Endotracheal anesthesia has a decided advantage in such a case, but with this method it becomes necessary to produce a deep preliminary anesthesia to overcome the tracheal reflex before the intubation. Vomiting may occur during this period or later as the patient is returning to consciousness. The bowels and the bladder should be emptied immediately before the operation. Observing this point will avoid much embarrassment and discomfort. If premedication is to be given, ample time must be allowed for it to become effective and the patient should lie in a quiet rest room with as little disturbance as possible for thirty minutes, or until the desired result is obtained. Avoid any noise, conversation or event that will upset the psychic equilibrium of the patient. Cultivate a technique and manner that will engender confidence. Seat the patient in a semireclining position, place the restraining straps, and the intraoral mouth prop with its appended string hanging out of the mouth. Adjust the nasal inhaler with the escape valve open. Start the anesthetic with a mixture suitable for the patient, usually a flow of 93 per cent nitrous oxide and 7 per cent oxygen. Gradually build up the flow as the mouth is covered securely. Make the change from the breathing of air to the anesthetic flow gradual enough that the patient cannot tell when the change is made. Avoid the sense of suffocation. Increase the flow until anesthesia is induced as indicated by the eye and muscle reflexes. Quickly insert the oropharyngeal pack to exclude the air and close the valve on the inhaler. After a 4 or 5 gallon flow has been reached, carry the anesthetic quickly through the excitement stage to avoid struggle and nausea. When the proper anesthetic level has been reached and the pulse and respiration are satisfactory, this level should be maintained as nearly as possible. A smooth anesthetic makes for a prompt uneventful recovery free from nausea.

POSTOPERATIVE PROCEDURE

After the operation, flush the lungs with oxygen, bringing the patient up through the area of nausea quickly, but do not move the patient from the chair. Have a kidney basin held to the lips that the patient may expectorate

with the least possible effort until full consciousness has returned. When the patient is able to move, assist him to the rest couch and insist upon his lying down for a few minutes. Unless the weather is extremely warm, he should be covered and kept comfortably warm. Be sure to observe this point because most patients perspire very freely under an anesthetic and unless the body heat is maintained, both during the operation and afterward, it may produce a postoperative pneumonia. If there is any delay of returning consciousness, the patient should be watched and stimulants used if necessary. Every precaution should be taken to clear the mouth of all débris, sponges, oropharyngeal pack, as well as blood and mucus. Even the position of the patient must be watched to be sure that a clear airway is maintained until the patient is in a condition to be able to attend to it for himself.

ANALGESIA

Many dentists are being caught in another one of those waves that periodically sweep across the country. This one is analgesia. You will be told that there is nothing to it, the patient does it all. A patient who dies under analgesia is just as dead as one who dies under full anesthesia. The chances may not be so great, but whenever any form of a general anesthetic is given, death is always a possibility. With the analgesia, nausea with its disastrous sequel is just one short step away and is always possible as the anesthetic fluctuates. Unless one is fully equipped as for surgical anesthesia and follows the same precautions, trouble is much more likely to occur and the medicolegal aspect would not be satisfactory. Our sense of responsibility to our patients should demand of us that we have a proper knowledge of the patient's ability to take an anesthetic and that our armamentarium be adequate.

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Case Reports

Two cases of focal infection are reported here. Readers who wish to discuss these cases should send their comments to Dr. Kurt H. Thoma, 47 Bay State Road, Boston, Mass. Readers are also invited to submit their own case reports.

CASE REPORT NO. 2

Duodenal Ulcer and Focal Infection

R. M. Winslow, D.D.S.,* Brooklyn, N. Y.

IN presenting this case history I hope it may prove to be "a good case of medical interest." It is possible for many of us to select from any number of histories involving degeneration of fundamental organs and tissues one case which will demonstrate medicodental relationship. The somatic degeneration is hastened in its development and is largely caused, we feel, by the injuries to the defensive forces of the body, particularly the blood stream, and is a result of focal infections, which would include dental infections. The different types of cases that come under this heading would include gastrointestinal disorders, nervous conditions, heart, kidney, eye lesions, joint pathology, and many other dysfunctions. In treating these dentally, we all have our successes and we also have our failures, but certainly the elimination of oral disease will tend to help the patient, whether he be ill or well. It is certain that many teeth are removed without the marked benefits that had been hoped for by the procedure, while the removal of others, though followed by instant benefits, later prove that the early optimism was unwarranted, because disease symptoms returned. Still other cases benefit by the removal of oral infections warranting the enthusiastic approval of patient, physician, and dentist. Consequently the importance of disease in the mouth must not be overlooked, even though the incidence between systemic disease and infected teeth remains a matter of varying opinion. In any case, it is agreed that conservative treatment, at least, is justified.

The relation of dental infection to gastrointestinal disorders has been studied by many. In some patients other foci are present and must be eliminated. In my experience, exclusive dental involvements as the only possible source of gastric pathology seem reasonably rare, and therefore the case to be presented, which falls into this category, should be of interest, as the removal of a tooth definitely and favorably altered the clinical course of a duodenal ulcer.

*Chief of the Department of Oral Surgery, Long Island College Hospital.
Presented at the Greater New York Dental Meeting.

History.—Mr. B., age 44 years, presented himself at the office of a physician complaining of severe abdominal pains and nausea. This discomfort had started approximately ten months before and was gradually getting worse. During the last two weeks, he vomited recently eaten food, and had regurgitated what seemed to him to be one-fourth cupful of blood. This condition was continuing. He had epigastric pain, and nausea two hours after every meal, being relieved by the next meal. A while back, a physician had attributed his condition to excessive beer drinking and a disorganized diet. On giving up beer and simplifying his diet he was immediately relieved, only to have the condition return a short time later. He also had symptoms of constipation, belching, and loss of appetite. The patient was brought to the hospital, where he was carefully examined in every respect. Family history proved negative, and past history produced information to reveal only the usual childhood diseases, and a history of successful tonsillectomy, and the removal of the appendix eight years earlier.

Fig. 1.—Case 2.

Examination.—Present condition revealed him as a reasonably well-developed person, well nourished, but perhaps a somewhat nervous and apprehensive individual.

Detailed examination revealed slight spasm in the region of the epigastrium; the liver did not appear enlarged; and the temperature varied between normal and 100°. The Wassermann test and urine analysis were negative.

A blood count showed 4,260,000 (5 million normal) red cells, 8,200 white cells (7,250 normal), hemoglobin 84 per cent, mononuclears 25 per cent, large mononuclears 72 per cent.

A fluoroscopy revealed the thorax and the esophagus normal, a small amount of scattered intestinal gas, and the stomach and duodenum appeared normal in both preliminary and full meals. The x-ray films, however, showed that the duodenal cap was irregular enough to be suspicious of an ulcer. The opinion of the attending physician was that the hemorrhage was due to a duodenal ulcer, which had begun to heal at the time of the x-ray study.

Treatment.—A week after hospitalization the dentist was called in consultation. He examined the x-ray pictures of the patient's teeth, taken at the time of the general x-ray examination. The maxilla proved to be edentulous, the teeth having been removed fifteen years earlier. There were ten mandibular

teeth remaining, all vital with the exception of the mandibular right first premolar. The canal of this tooth had been filled. At the apex there was a rarefied area, indicating periapical resorption or infection (Fig. 1). The patient was advised that this tooth should be removed, and the extraction was performed with novocaine anesthesia on the following day. The healing of the socket proceeded in a normal way, and the following week the patient was allowed to return to his home, not a well patient by any means, but he was resting far more comfortably than on admission to the hospital.

Slowly, very slowly, but surely, the patient regained his health. The nausea stopped, his abdominal discomfort and associated symptoms disappeared, and he returned to a normal state of health, seemingly in about three months—nothing spectacular, but interesting. Since then he has very gradually returned to normal dietary habits, and has practically forgotten that he ever had any gastric or duodenal trouble. In the opinion of a well qualified gastroenterologist, the recovery of the ulcer seemed not to be as important a result as the fact that no new ulcers formed. All simple ulcers heal even though nothing is done, but the important thing is to prevent new ulcers.

Discussion.—Because of the fact that the only definite procedure done for this patient was the extraction of a periapically infected tooth, his physician attributed his subsequent recovery to the removal of dental infection, to which I was inclined to agree.

144 Joralemon Street

CASE REPORT NO. 3

Eye Involvement From Dental Infection

R. M. Winslow, D.D.S., Brooklyn, N. Y.

History.—Mrs. C., age 34 years, presented herself at the office of an ophthalmologist complaining of extreme pain on the left side of the forehead and around the left eye. This pain was intermittent in character. There was increased lacrimation and photophobia, and a feeling of some foreign body in the left eye. The headache had begun over the left eye a few days previously when a redness of the eye was noticed. She had received treatment, but the symptoms did not subside. The pain continued referring to the temporal region. Two days later the left eye began to water greatly, and the patient noticed that the light hurt this eye also. The condition continued with increased pain, increased lacrimation, and photophobia for two more days until she was brought to the hospital. She was hospitalized, and was carefully examined in every respect.

Examination.—Family history proved negative and the past history showed mainly that she had had rheumatism at the age of eight years with no recurrence, and that she had had two children, with normal births.

Present condition showed her a well-nourished, well-developed person with no past history of eye trouble. The general physical examination was negative; all organs were found normal except that the mouth and teeth were reported to be in a poor condition. The Wassermann and urine examinations were negative. A blood count showed 9,200 white cells, hemoglobin 86 per cent, polynuclear neutrophils 78 per cent, small mononuclears 20 per cent, mononuclears—large 1 per cent, and transitionals 1 per cent.

The report of the ophthalmologist was as follows: "Moderate ciliary congestion of the left eye. Pupil regular, but dilated only one-half of maximum. Springing from the lower temporal quadrant of the major circle of the quadrant are several weblike strands of exudate adherent to the anterior capsule. The general shape of the exudate is that of a wedge with the apex about two-thirds of the way upward to the center of the pupillary area. No involvement of the right eye."

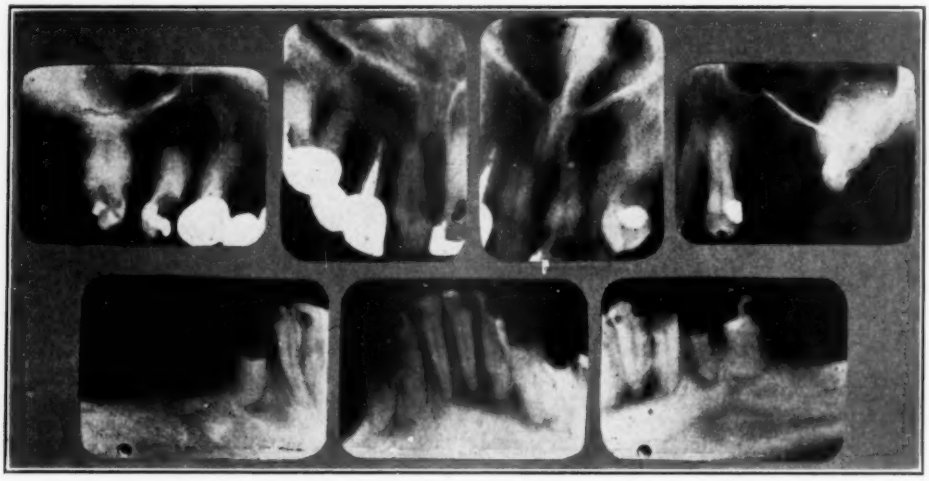

Fig. 1.—Case 3.

The following day congestion was about the same, and for the following few days the treatment consisted of application of adrenalin packs in the upper cul de sac after butyn instillation, hot boric acid compresses, ephedrine sulphate nose sprays, atropine both 1 per cent and 4 per cent, with but slight relief to the patient.

Roentgen Examination.—Five days after hospitalization, it was possible to order x-ray examination of the sinuses and of the teeth. The former proved negative as to pathologic findings. The dental x-ray pictures revealed that of the eight remaining mandibular teeth, there was periapical rarefaction, indicating an infection, about the roots of seven teeth, or all but one; of the nine remaining maxillary teeth, all were normal but one which showed definite periapical rarefaction indicating infection. This was the left second bicuspid. It was advised that these teeth be removed, as well as the other teeth which remained, because of their badly broken down character. There was no evidence of root canal treatment in any of these teeth, except the maxillary left lateral incisor (Fig. 1).

Dental Consultation.—At this time, I, as the dentist, was called in consultation and found the mouth and the teeth in a very neglected condition. There were several carious teeth, and there were several badly broken down teeth. Several teeth were missing and two had ill-fitting crowns. Yet the gingivae looked reasonably healthy, and no sinuses could be detected through which pus might be escaping, and there was no swelling.

Treatment.—One week after hospitalization, four teeth were extracted under novocaine, the maxillary left second incisor, the first premolar, the second premolar, and the first molar. Two days later the five remaining maxillary teeth were removed, the right and left first incisors, the right second incisor, cuspid, and first molar. And four days later the eight mandibular teeth followed, the left first incisor, second incisor and cuspid, and the right first and second incisors, cuspid, first and second premolars. To extract at one time so many teeth is usually contraindicated, but rules have to be broken in times of emergency.

After the first extractions the only noticeable difference in the eye condition was that the pupil seemed more widely dilated. After the second extractions the pupil had fully dilated, the exudate had entirely disappeared, but the pain was only slightly diminished. The day following the last extractions the patient was completely comfortable, and the eye practically normal, seemingly a complete recovery. In passing I might report that during hospitalization it was suggested that the tonsils might be a possible focus of infection, and it was planned to have them removed at a later date, but this procedure was never carried out.

Result.—It has been five years since this pathologic condition arose, the patient has visited my office, and there has been no recurrence of any pathologic condition.

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DISCUSSION

Dr. Harold A. Kent, Assistant Professor of Oral Surgery, Harvard University Dental School.—There is no doubt that the conception of the theory of focal infection or of systemic disease resulting from oral foci varies with different medical and dental groups. The evidence that such a relation exists seems to rest almost entirely with clinical rather than laboratory evidence; that is, a patient's recovery or death may be coincident with the eradication of oral infection. Because Koch's postulates cannot be demonstrated in the diseases secondary to focal infections, some discredit the idea entirely. Clinical evidence, however, strongly suggests the relation of oral infection and systemic disease, and another group enthusiastically approve of the association.

I agree with Dr. Winslow when he says that "the importance of disease in the mouth must not be overlooked even though the incidence between systemic disease and infected teeth remains a matter of varying opinion," and I will not disagree that the removal of the dental infection might have cured the duodenal ulcer. Mention, however, is made that the ulcer had begun to heal at the time of the x-ray study. One week following the x-ray study, the tooth was removed and slowly but surely the patient regained his health. During his recovery, an ulcer diet was maintained which certainly must be considered as definite a procedure as the removal of the tooth. Which contributed more to his recovery must be a matter of opinion.

In the case of the eye involvement from dental infection it would be interesting to know whether all, one, or a few of the teeth removed were causative factors in the disturbance of

the left eye reported by Dr. Winslow. The dental examination and other reported clinical experiences would suggest that the maxillary left second bicuspid was the most important source of infection.

Rosenow has stated that those lesions in the eye, associated with exudation, are usually due to actual localization of the organisms, while milder manifestations may be due to toxins which reach the eye through the blood stream.

Dr. Bulson in his case analysis found that approximately 87 per cent of all cases of endogenous iritis are due to three causes; namely, syphilis about 33⅓ per cent, dental infection 33⅓ per cent, and tonsillar infections 20 per cent. When the eyeball or its surrounding structures are affected, the mouth should be freed of all evident or suspicious areas of infection. Other clinical reports consistent with this case warrant such action.

Dr. Max H. Jacobs, Oral Surgeon, Forsyth Dental Infirmary, Boston, Mass.—A marked change has occurred in the viewpoints of the dental and medical professions in relation to results obtained by removal of foci of infection. In 1911, following the expounding of the focal infection theory, practically all devitalized teeth were ordered extracted by physicians treating such diseases as rheumatism, arthritis, and gastric and duodenal ulcers.

When Rosenow demonstrated in animals the formation of gastric ulcers and iritis following injection of bacteria from the apices of devitalized teeth, another wave of dental radical procedures took place. Experience, however, has shown that the experimental results attained in animals have not proved the same in the human animal. The electivity of bacteria for certain tissues in the human has not been entirely confirmed. Nevertheless, there is a certain amount of clinical evidence tending to prove that there are a number of conditions which linger on in spite of prolonged therapy, and which appear to clear up after the removal of foci of infection; and in my opinion, suppurative pyorrhea is of more importance than well-walled-off chronic apical abscesses or granulomas which, many times, have been found sterile.

The question of improvement following removal of dental infection in duodenal ulcers is uncertain. It is well known that the symptoms of duodenal ulcers occur periodically; that there are periods of remissions and exacerbations; that the intervals of relief, in some cases, may extend over a longer period of time than other cases. Cure following removal of dental infection, therefore, may be coincidental or problematical.

On the other hand, there is a great deal more of clinical evidence pointing to dental infection as an etiologic factor in diseases of the uveal tract of the eye. If syphilis, rheumatism, tuberculosis and trauma can be ruled out, focal infection must be taken into consideration. In my own practice I have records of a number of cases of recurrent iritis which remained cured only after removal of dental infection.

Nevertheless, conservatism must become the keynote. There have been far too many teeth removed in the attempt to cure some condition, the symptoms of which recur, leaving the patient with the original disease in addition to lessened masticatory function.

Department of Orthodontic Abstracts and Reviews

Edited by

DR. EGON NEUSTADT, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. Egon Neustadt, 133 East Fifty-Eighth Street, New York City.

The Results of Nutritional Experiments With Hard Bread. By Professor Dr. S. Korkhaus. "Kampf der Karies" No. 8, 1937.

The author reports on experiments which were carried out in order to determine whether, and to what extent, the regular use of hard bread influences the favorable development of the masticatory apparatus and the general body health. The experiments were conducted on 143 children in the orphan asylum of the city of Cologne; half of them were given, for a period of two and one-half years, hard whole rye bread while the rest of the children continued on the usual soft bread portions.

Two periods in developmental stages were selected: one group representing children from 4 to 6 years of age, with deciduous dentitions, where changes in length and breadth of the jaws could be expected during the time of the experiment as a result of the development of the first permanent molars and the permanent incisors. The second group included children from 6 to 9 years in whom the growth of the jaws during the time of changes from deciduous to permanent dentition could be studied.

In the following, the results of the experimental studies are given in condensed form: The children eating the hard bread showed a smaller increase in caries than the others. It may be assumed that the hard bread brought about a higher degree of self-cleanliness of the teeth. Measurements of masticating pressure gave, for obvious reasons, a much more satisfactory result for these children. An examination of their ability to grind and triturate food, however, showed no important differences between the two groups.

The development of the dentition as a whole took a more favorable course in the children fed on hard bread than in the others. These differences were demonstrated in the growth of the dental arches as regards both their breadth and their length; in the reception of the permanent incisors and first molars within the arches; in the correct arrangement of the incisors; and, most conspicuously, in the mesiodistal relationship of the mandibular to the maxillary arch. Malpositions which originated in occlusal malrelations showed no improvement as such self-corrections could be accomplished only through better masticatory function over the course of many years; the experimental period of two and one-half years was evidently too short. The preponderance of

favorable developments in the dentitions of the children eating hard bread was so marked that it is beyond the possibility of a chance finding; but must be attributed to the better functional stimulation of the jaws.

The general health of both groups of children was found to be equally satisfactory because the rest of their diet was well selected and diversified.

Korkhaus concludes from the findings of the experiment that there exists, within the region of dentition and jaws, the basis for gradual changes to the requirements of foods, not only in regard to their biochemical, but also in regard to their physical characteristics.

Dr. Haas (Cologne).

Editorial

Bone and Vitamin C

AT A MEETING of one of the sections of the American Academy of Pediatrics held in Boston last November, an outstanding feature of the program was a symposium devoted to the relative merits of vitamin C. From this discussion pediatricians have obtained many practical suggestions which are directly applicable to their everyday work. Much attention was given to scorbutus, which is characterized as "the inability of supporting tissues to produce and maintain intercellular substances." Whatever other rôles vitamin C plays in the chemistry of the body, it is claimed that it is indispensable for the formation of all intercellular substances; of fibrous tissue structures, of the matrices of bone, tendon and cartilage, and particularly of certain "cement" substances. These conclusions were stressed as a result of histologic studies of human scurvy in children and also studies of progressive scurvy in growing guinea pigs and of the repair following the administration of vitamin C.

For example, it was pointed out by Burt Wolbach, M.D., that normal growth sequences are maintained in endochondral bone formation. It was demonstrated by others that tooth formation in the guinea pig is definitely affected by the scorbutic process in just as marked a degree as bone formation and that, in both man and the guinea pig, normal ascorbic acid nutrition is essential for the maintenance of the tissues by which the teeth are attached to the jaws. It is said that loosening of the teeth in certain acid deficiency is the result of a breakdown of the cells which govern production and maintenance of the tooth-suspending tissues.

These conditions may be quickly brought about by a vitamin C deficiency; also they may quickly take a turn for the better when a proper supply of this vitamin is provided.

When Cryer wrote in 1901 that "the most important factors concerned with the formation of the variations of the anatomy of the face, head and skull are nutrition and occlusion of the teeth," if the importance of vitamin C had been known at that time, he would no doubt have added that we cannot have normal nutrition of bone material without an ample supply of vitamin C in the diet.

By clinical experience, orthodontists have been among the first to discover that bone can be successfully changed in form by mechanical means in some children, while in others with similar deformities the response to mechanical treatment is highly unsatisfactory. There has been much discussion on this subject.

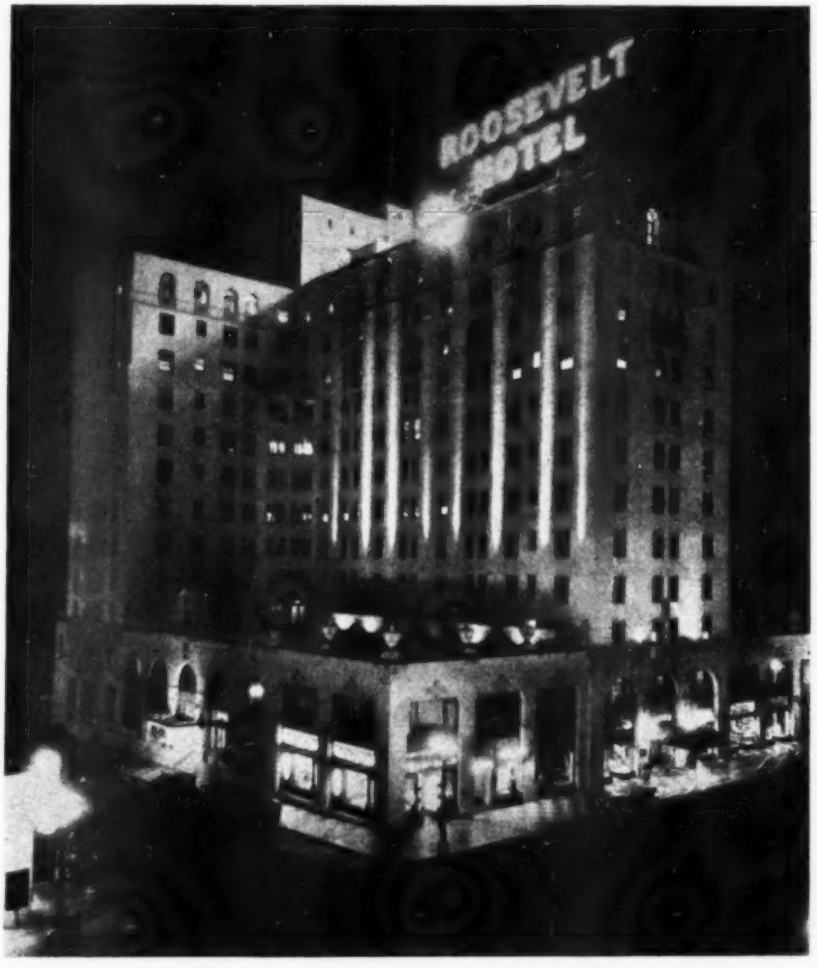
More and more it is being realized, as the orthodontic field is further penetrated, that health is the most important consideration in being able to secure a satisfactory and permanent result in the treatment of malocclusion, because without normal nutrition the biological processes of bone growth do not respond satisfactorily and permanent results become speculative in character. Pediatricians in their search for etiologic factors in studying certain bone and nutritional diseases can contribute much to the orthodontic problem.

H. C. P.

News and Notes

The 1938 Meeting of the American Association of Orthodontists

A preview of the coming meeting of the American Association of Orthodontists reveals all the essential factors which will justify a large attendance. When the meeting opens its sessions, beginning with registration on Monday, July 11, it will be the thirty-sixth time our Association has come together, but the first occasion when such a meeting has ever been held



The Hollywood Roosevelt Hotel, headquarters and meeting place of the American Association of Orthodontists, July 11 to 14.

upon the Pacific Coast. For this reason the members voted to change the usual meeting dates from the month of April to July, the thought being that many of our group would combine a summer vacation trip with the serious and helpful features available in our annual conclave.

In the selection of a meeting headquarters, the Local Arrangements Committee has altered the usual custom of naming a hotel in the metropolitan district and has chosen the

Hollywood Roosevelt Hotel, located in the heart of one of Los Angeles' most interesting suburbs. Not only is the hotel itself delightful and well equipped for all of our sessions, with air cooled meeting rooms and other accommodations to favor meeting facilities, but it lies within the center of the film capital of the world, with its many art attractions of universal interest. In addition to these, a big part of the broadcasting stations, which carry programs of national interest, are located in the immediate neighborhood, so that part of our entertainment feature may easily include the witnessing of many of these. In other words, you may see at first hand your favorite radio star.

The hotel is also conveniently located to the various country clubs, beaches, museums, the famous Hollywood Bowl, with its equally famous "Symphony Under the Stars," the Pilgrimage play, the motion picture studios, aand many other sources of delightful and stimulating entertainment. For those addicted to golf, and who participate in the annual golf tournament which precedes our scientific sessions, a real treat is awaiting, for the Bel-Air Country Club, which is one of Southern California's finest, has opened its doors to our members on that day.

From the foregoing, which is but a brief outline of the possibilities from the standpoint of the social side of our meeting, our readers must remember that the chief and main attraction will be our program. After all, were it not for what we gain in increased efficiency, enthusiasm and morale, our organization would not be justified. We believe that the program, which is now almost complete, will prove to be one of the most helpful in our history. From its very inception it has been dedicated "To helping every member meet the problems of daily practice in a better and more complete way." Its sole content will be directed to the things we must work with and think about and strive for in meeting the problems of orthodontics.

Selected at random will be found such subjects as the following: "The Evolution, Development, and Application of Myofunctional Therapy in Orthodontics"; "Fundamental Factors in Bodily Growth and Their Relation to the Orthodontic Problem"; "The Place of Chrome Alloy in Modern Orthodontics"; "The Control of Inflammatory Conditions of the Oral Mucosa During Orthodontic Treatment"; "Nutritional Corrections as an Aid in Overcoming Growth Deficiencies in the Oral Structures"; "The Place of the Lingual Arch in Orthodontic Therapy"; a symposium "Why Do We Have Orthodontic Failures?"; and many other subjects all equally practical and timely. In addition to the essays, four special group clinics, to be witnessed by the entire membership, are in process of preparation, and a wealth of general clinics in which a large number of our members will participate. This list of program material does not include all the essays which have been arranged for, nor are any names given at this time, for these will all appear in a later and more accurate outline of the course which the program will follow. We are hopeful, however, that this brief announcement will stimulate our members to make definite plans for July, and let their slogan be the title of that famous song, "California, Here I Come!"

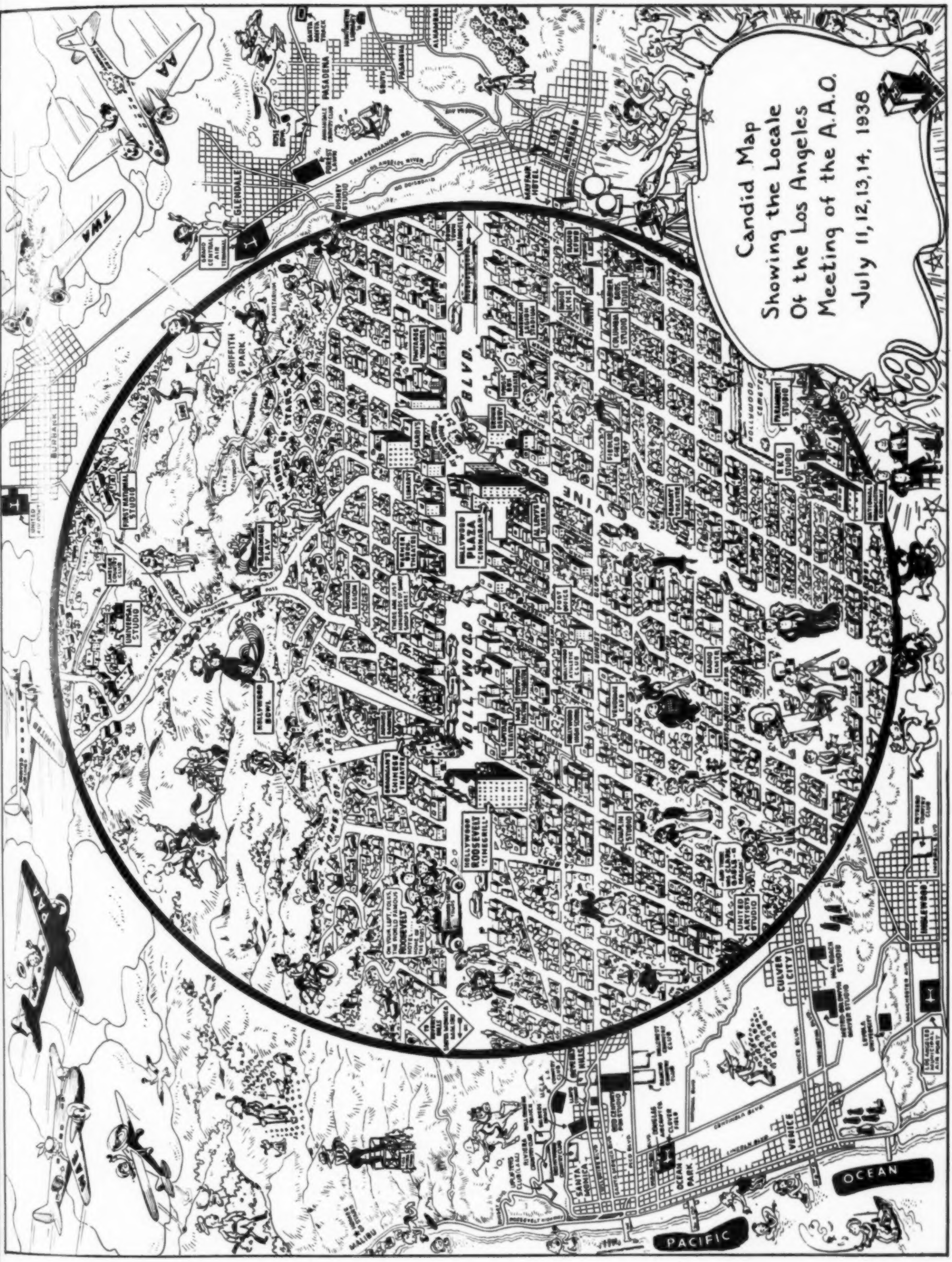
Fraternally yours,

James David McCoy, President,
3839 Wilshire Blvd.,
Los Angeles, Calif.

American Board of Orthodontia

A meeting of the American Board of Orthodontia will be held in Los Angeles, July 8, 1938.

Orthodontists who desire to qualify for certificates from the Board should secure the necessary application blanks from the secretary. The applications must be returned to the secretary, together with any other required credentials, at least sixty days prior to the date of examination. Applications filed at the time of the Board meeting will have preliminary consideration, so that the applicant may be advised of the work required for his subsequent examination.


Candid Map
Showing the Locale
Of the Los Angeles
Meeting of the A.A.O.
July 11, 12, 13, 14, 1938
HOLLYWOOD
BLVD.
VINE
GRIFFITH PARK
GLENDALE
BURBANK
PASADENA
HOLLYWOOD BOWL
UNIVERSAL STUDIO
CULVER CITY
SANTA MONICA
OCEAN PARK
VENICE
MALIBU
PACIFIC
OCEAN
TWA
AA
PAA

Attention is called to the following resolutions adopted by the Board: Any person desiring to make application to the Board for a certificate must have been in the exclusive practice of orthodontics for a period of not less than five years or an equivalent to be determined by the Board and based upon the following conditions:

1. He must be an instructor in orthodontics in a school satisfactory to the Board.
2. He must be an associate in the office of an orthodontist whose standing is satisfactory to the Board.
3. It is definitely to be understood that any person at the time of making application for a certificate shall be in the exclusive practice of orthodontics in his own name.

For further information please address

CHARLES R. BAKER, Secretary,
636 Church Street,
Evanston, Ill.

Dental Society of State of New York

The seventieth annual meeting of the Society will take place May 10-13 at the Hotel Syracuse, Syracuse, New York.

DR. EDWIN I. HARRINGTON, President
Woolworth Building
Watertown, N. Y.

North Carolina Dental Society

The sixty-fourth annual meeting of the North Carolina Dental Society will be held at the Robert E. Lee Hotel in Winston-Salem, N. C., May 2-4, 1938. All members of the American Dental Association are cordially invited to attend.

FRANK O. ALFORD, Sec.-Treas.,
1109 First National Bank Bldg.,
Charlotte, N. C.

European Orthodontilogical Society

The annual meeting of the Society will be held in London July 14 and 15 under the presidency of Dr. Harold Chapman.

American Dental Assistants Association

The fourteenth annual session of the American Dental Assistants Association will be held at St. Louis, October 24-28. For further information, address

LUCILE S. HODGE, Secretary,
401 Medical Arts Bldg.,
Knoxville, Tenn.

American Dental Hygienists' Association

The American Dental Hygienists' Association will meet October 24-28 at St. Louis.

DAISY M. BELL, Secretary,
974 Amherst Street,
Buffalo, N. Y.